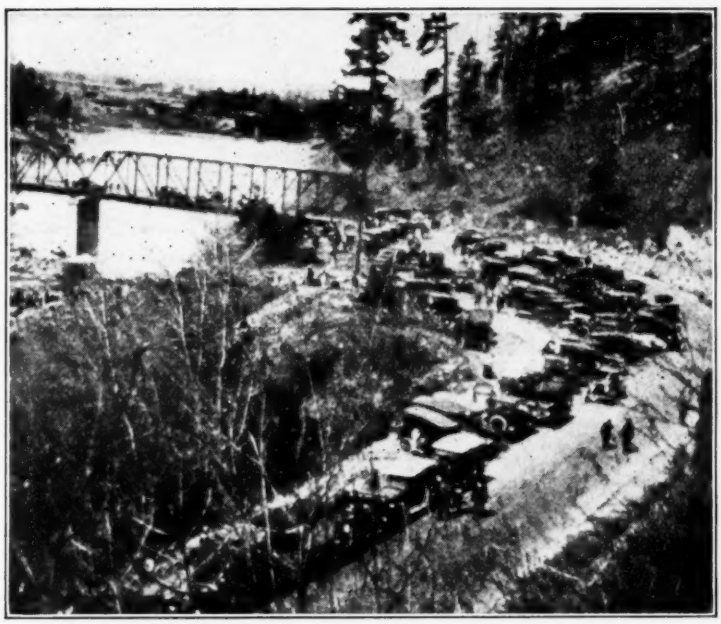
Compressed Stone Base for Warrenite-Bitulithic Pavement

This form of base has been thoroughly and successfully tested for many years under widely varying climatic and subsoil conditions, and has proven eminently satisfactory, including over 200 miles on the Columbia River Highway, Oregon, shown in illustration below.



COLUMBIA RIVER HIGHWAY, PORTLAND, OREGON
Warrenite-Bitulithic Surfacing over Old Macadam Sandy Road. Approach to the Columbia River Highway at Sandy River Bridge.

SERVICE AND QUALITY

the essential features in laying of Warrenite-Bitulithic. We furnish expert laboratory service with every pavement laid. The result is shown by the phenomenal growth of Warrenite-Bitulithic.

INSIST ON THE WARREN WAY

Illustrated Booklet on Compressed Stone Base furnished upon request, as well as other features of Warrenite-Bitulithic.

Warren Brothers Company

Executive Offices: 9 Cambridge St., Bowdoin Sq., BOSTON, MASS.

DISTRICT OFFICES:

New York, N. Y.	St. Louis, Mo.	San Francisco, Cal.	Vancouver, B. C.
Utica, N. Y.	Phoenix, Ariz.	Richmond, Va.	Toronto, Ont.
Portland, Ore.	Washington, D. C.	Memphis, Tenn.	Winnipeg, Man.
Chicago, Ill.	Minneapolis, Minn.	Los Angeles, Cal.	

Proven Performance

THE economical moving of materials by means of the Scoop Conveyor is not a matter of guess, but a fact actually established and many times proven by the performance of thousands of scoop conveyors now in actual and successful operation in all parts of the world.

It saves time, labor and money in storing and reclaiming, in loading and unloading—cars, trucks and wagons.

ask any user

Let us show you conveying efficiency and how to add into your investment one more factor of speed and economy. Send for Catalog No. 100.

Portable Machinery Co.

PASSAIC, N. J.

THE SCOOP CONVEYOR

Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXI. JULY, 1921 No. 1

CONTENTS

EDITORIALS

Great is the Construction Industry 1
Highway Pavement Edging 2
The Ultimate Gasp in Detours 2

LEADING ARTICLES

Movement to Award Road Contracts in Fall Instead of Spring 3
Sewage Tanks Again 4
Clay Products Research Work Launched 6
Construction Analyzed and Rated Basic Industry by U. S. Chamber of Commerce .. 7
Efficiency of Different Types of Car-Stop Safety Zones 7
Some Engineering Features of Brick Paved Roads 10
Fire Alarm Systems in Smaller Municipalities 12
Equitable Distribution of Cost of Constructing and Maintaining State Highways .. 14
Improving Gravel Streets in Grand Rapids, Michigan 15
The Cost Factors of Consulting Engineering Practice 17

WATER WORKS SECTION

Water Treatment for Small Municipalities 23
Economies of the Boiler Room 26
Maximum Demand Controller for Large Water Consumers 30
Water Works Reports and What They Should Contain 31
Measuring Depth to Water in Well 34
What Happened in a "One Man" Water Plant 34
Water Purification for Towns on Tidal Rivers 36

CONSTRUCTION NEWS AND EQUIPMENT SECTION

Economic Choice of Road Construction Plant Units and Layouts 21
Planning and Organizing a Road Construction Job 26
Grading Both Sides of Road at Once 32

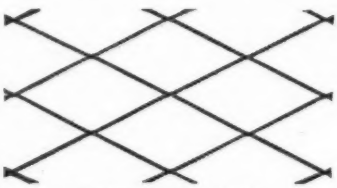
Price: Single copy 25 cents. Annual subscription in U. S. $2.00; Canada, $2.40; Foreign, $2.75.

MUNICIPAL AND COUNTY ENGINEERING is published monthly by Engineering Publishing Company, 702 Wulsin Building, INDIANAPOLIS, INDIANA, A. P. Fox, President, J. H. Pritchard, Secretary.

Changes of address, subscriptions and remittances should be addressed to MUNICIPAL AND COUNTY ENGINEERING, Indianapolis, Indiana. Editorial and business communications should also be addressed to 702 Wulsin Bldg., Indianapolis, Ind.

Editorial and Advertising Offices also at 702 Wulsin Bldg., Indianapolis, Ind. Samuel C. Hadden, Editor and General Manager.

Reinforcing Steel Saves Expense on Concrete Roads



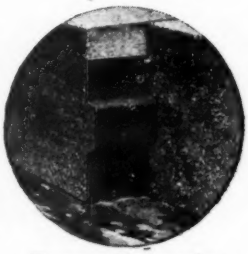
Truscon Road Mesh

Reinforcing steel increases strength and reduces maintenance.

Truscon Products insure the right reinforcement for concrete roads.

Truscon Road Mesh is an expanded metal with 6x12-inch diamond mesh—furnished in flat sheets 5 feet wide and various lengths.

TRUSCON STEEL CO. TRUSCON BUILDING PRODUCTS



Truscon Contraction Joint

Truscon Wire Mesh

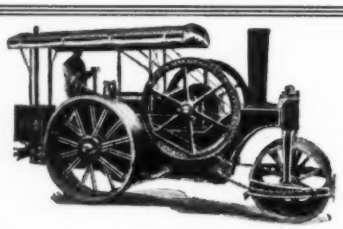
Truscon Wire Mesh is furnished either in rolls or in large flat sheets, easily handled and placed.

The use of Truscon Contraction Joint completes and perfects the construction. Write for literature and estimates.

Truscon Steel Co.

YOUNGSTOWN, OHIO

Warehouses and Representatives in Principal Cities.



100% Dividends

In Service and Satisfaction

AUSTIN ROLLERS haven't joined the ranks of the investments that pass dividends in hard times and they never will. On the job every minute and staying there for years, they are a sure source of constant satisfaction and profit to contractor or public official.

Three-wheeled Rollers in two types—Motor and Steam—with or without Scarifier Attachment—and in five sizes. Satisfy all requirements and suit all tastes. Four sizes of Tandem Rollers, but only the Motor type, which has proved to be in a class by itself.

Your copy of the New Austin Roller Catalog, just off the press, will be on its way within an hour of the time your request reaches us.

IT'S WORTH ASKING FOR.

The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS

Albany	Chicago	Jackson	New Orleans	Portland	San Francisco
Atlanta	Columbus	Kansas City	New York City	Richmond	Topeka
Billings	Dallas	Los Angeles	Oklahoma City	St. Paul	Wahoo
Boston	Denver	Nashville	Philadelphia	Salt Lake City	Phoenix

ALMACO — EXPORT DEPARTMENT ALLIED MACHINERY COMPANY OF AMERICA — ALMACO

ST LOUIS AND

Texaco Sheet Asphalt on Kingshighway, St. Louis, Mo.

Progressiveness has always marked the city of St. Louis. It staged the spectacular World's Fair in 1904. It has maintained itself as the hub of the country's fur trade, and may boast of a mammoth boot and shoe industry, in addition to being the business center of its section.

As one of America's leading cities, St. Louis believes in doing things right; it is indeed progressive.

Newstead Ave., St. Louis, Mo., paved with TEXACO Sheet Asphalt in 1919.

In keeping with its all-around progressiveness, St. Louis has paid vital attention to its paving problems. Expert engineering knowledge and the best of materials have been employed in building the excellent streets and boulevards of which it is proud.

The Texas Company, too, is proud of the part TEXACO has played in the construction of the Mound City's durable, resilient asphalt pavements.

TEXACO

The Texas Company

Asphalt Sales Dept., 17 Battery Place, New York City

New York Houston Richmond Philadelphia Jacksonville Boston New Orleans Atlanta Chicago Memphis Oklahoma City Cleveland Minneapolis Kansas City Wichita Des Moines

SPRINGFIELD PAVING BRICK

ARE WIDELY USED

Springfield Paving Brick Company

SPRINGFIELD, ILLINOIS.

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

Concrete Reinforcement

Fulfills every engineering requirement.

Send for our book on road building.

CHICAGO
NEW YORK
CLEVELAND
PITTSBURGH
DENVER

Advertising in Times of Depression

By Carl H. Greene, Sec'y-Treas. Export Managers' Club of New York

EVER since America became the advertising nation, we have been exceedingly proud of our position as the leader in this form of sales promotion, and most of us have looked condescendingly on the manner in which foreign manufacturers use space to feature their wares. As a recently returned traveler said at the Export Managers' Convention, "The Europeans are in the kindergarten of advertising," and, compared with our highly specialized use of the printed word for business purposes, he was right.

Yet how inconsistent we are. In advertising we have a proven medium for creating business—a method backed by years of use in developing sales, good will and a better knowledge of our products. But at the first intimation of a slackening in business we lop off the advertising appropriation as the first step in retrenchment.

This is no new development in American character, as every advertising manager knows. We have had this practice of "cutting off the advertising" when dull times come, ever since we learned to advertise.

However, one would naturally suppose, if advertising is a business producer, that it could be used more effectively when trade isn't good than when we are flush with orders. There are certain wise merchandisers, though, that do take advantage of their competitors' timidity to push their sales promotion when their fellow tradesmen have backed out of the public eye.

Back in 1907, when the panic of that year curtailed business, a maker of a now famous belting was discussing conditions with a group of doleful manufacturers in the power transmission field. One of these men expressed great surprise that the belt-maker was continuing his advertising. The latter replied, "Then you'll be more surprised next week, for I have ordered double-page spreads for all my advertising and have put on three more salesmen." And he kept consistently to this program of increased advertising and selling throughout that period of depression, with the result that his competitors now spend double and triple his appropriation to hold their own with him.

EXPLOSIVES ~ SERVICE

Saving the Users of Explosives Over $1,000,000 Every Year

Branch Offices:
Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Chicago, Ill.
Denver, Colo.
Duluth, Minn.
Huntington, W.Va.
Joplin, Mo.
Juneau, Alaska.
Kansas City, Mo.
New York, N. Y.
Pittsburgh, Pa.
Portland, Ore.
St. Louis, Mo.
San Francisco, Calif.
Scranton, Pa.
Seattle, Wash.
Spokane, Wash.
Springfield, Ill.

Du Pont Products Exhibit
Atlantic City, N. J.

BY developing new types of explosives that are more efficient and more economical than those of yesterday, our staff of over 300 chemical engineers have made possible a very substantial saving to users of explosives.

The two most notable developments in the explosives industry since the introduction of dynamite in 1866—low-freezing ammonia and permissible powders—came from the Du Pont Laboratories, where constant efforts are still being made to bring them to a still higher state of perfection.

The introduction of these two powders is saving explosives users 1c a pound on approximately 100,000,000 pounds a year, for not only is their cost less on the basis of equal nitroglycerin content, but lower "strength" of these powders can be used to accomplish equal results. Besides contributing to economical use of explosives, these powders have reduced the hazards to life and property to a very large degree, resulting in the saving of a vastly greater sum.

Constant research and improvement is merely one phase of Du Pont Explosives Service. Vast facilities for production, supervision hitherto unknown in point of accuracy to insure uniform high quality, a great chain of distributing magazines, a fine force of *practical* explosives experts in the field combine to make a Service complete in every detail.

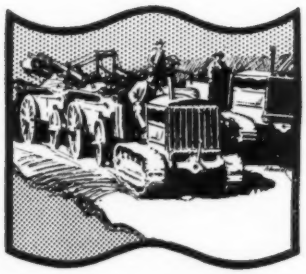
We suggest that you take advantage of Du Pont Explosives Service in *your* work—as so many thousands of others have done in their work.

E. I. du Pont de Nemours & Co., Inc.

Sales Department: **Explosives Division**

Wilmington, Delaware

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING



Bring Your Equipment Up to Date

The dirt-mover who uses a "Caterpillar"* Tractor with his elevating grader, cuts his costs to the lowest figure. No other method is so economical and so profitable. A fleet of 5-ton "Caterpillar"* Tractors, pulling dump wagons, completely displaces mules—handles more dirt per day—and *keeps going*. Complete motorized "Caterpillar"* outfits are used by the leading contractors the world over. Our motion picture film, "The Nation's Road Maker," will interest you—write, or telephone for further information.

THE HOLT MFG. COMPANY, *Inc.*
PEORIA, ILLINOIS
Eastern Division: 50 Church St., New York
Branches and service stations all over the world

CATERPILLAR
Reg. U.S. Pat. Off.

HOLT
PEORIA, ILL.
STOCKTON, CALIF.

**There is but one "CATERPILLAR"—Holt builds it*

FREE

Information, Specifications, Literature and Expert Engineering Advice About

GRANITE

for

PAVING AND CURBING

The Granite Paving Block Mfrs. Association of the U. S., Inc.
31 State St. BOSTON, MASS.

Representing

THE WORLD'S GREATEST GRANITE QUARRIES

"PIONEER" Highest Quality ASPHALTS

"PIONEER"

Highest Quality Asphalts

Any Melting Point, Any Ductility, Any Penetration

We are Asphalt Specialists, and there is now a PIONEER product complying with practically every Asphalt or Bituminous specification. Let us quote you on your requirements.

OUR POLICY: "A personal interest in every order; an earnest endeavor to please."

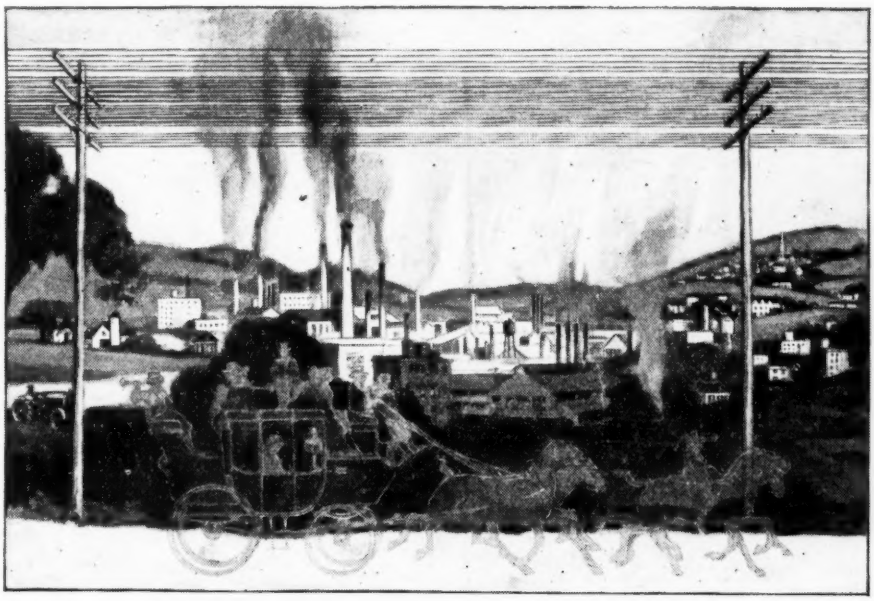
"PIONEER"

Ruberoad Cement

It's New It's Different It's Efficient

A product that will interest every engineer and contractor; especially made and adapted for repairing cracks in concrete roads and pavements.

THE PIONEER ASPHALT CO.
LAWRENCEVILLE, ILL.



". . . places far apart are brought together, to the present convenience and advantage of the Public and to the certain destruction, in time, of a host of petty jealousies, blindnesses and prejudices, by which the Public alone have always been the sufferers."
From Charles Dickens' Preface to Pickwick Papers.

The Advance of Understanding

Even romance of sixty brief years ago could not imagine the great advance heralded by the passing of the stage coach. The railway and telegraph were coming into their own; but the telephone had not been so much as dreamed about.

Yet the wise men of that day saw the imperative need. They saw the value of every step which brought people into closer communication with each other. They knew this to be the one way to increase understanding; and to eliminate the "host of petty jealousies, blindnesses and prejudices, by which the Public alone have always been the sufferers."

Then came the telephone. And with its coming time and distance are swept away and a hundred million people are made neighbors.

Places far apart are brought together by 34,000,000 conversations a day over the Bell System.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service

"BEREA"
Sandstone Curbing
Pioneer in the field
PRODUCED BY
The Cleveland Stone Co.
Main Offices:
Union Bldg., 1836 Euclid Ave. CLEVELAND, OHIO
Western Offices:
Room 1112 Merchants Loan & Trust Bldg., Chicago

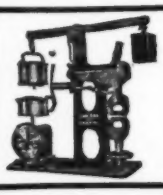
WM. E. DEE COMPANY
30 North LaSalle St. CHICAGO, ILL.

WE MANUFACTURE
D & D Safety Cover
Guaranteed not to Rattle or Dish.
Full Line of MANHOLE and CATCH BASIN COVERS of all kinds.
Patent Numbers—985163-1177850
WRITE FOR OUR PRICES

ACME
Manholes, Catch Basins, Inlet Basins, Park Basins (All Styles)
Regular and Special Grates or Strainers for Sewer Pipe

Building Columns of All Descriptions
Send Us Your Specifications
MADISON FOUNDRY CO.
927 Addison Road, CLEVELAND, OHIO.

No tar adulterant in this oil—that's why wood blocks treated with it won't bulge or bleed
REILLY'S IMPROVED PERMANENT CREOSOTE OIL
REPUBLIC CREOSOTING COMPANY, Indianapolis, Ind.
Plants: Indianapolis Minneapolis Mobile Seattle Norfolk


New Automatic Cement Tester
Grand Prize Panama-Pacific International Exposition, 1915.
Manufacturers of Cement, Concrete, Brick and Road Material Testing Machines and All Auxiliary Laboratory Apparatus
TINIUS OLSEN TESTING MACHINE CO. 500 North Twelfth St. PHILADELPHIA, PA.

SEWER PIPE — FIRE BRICK
Flue Linings — Wall Coping — Steam Line Conduit — Sewage Disposal Tanks — Fire Clay Meter Boxes
IN STRAIGHT OR MIXED CARS. Manufactured of OHIO RIVER FIRE CLAY.
CANNELTON SEWER PIPE CO., Cannelton, Ind.

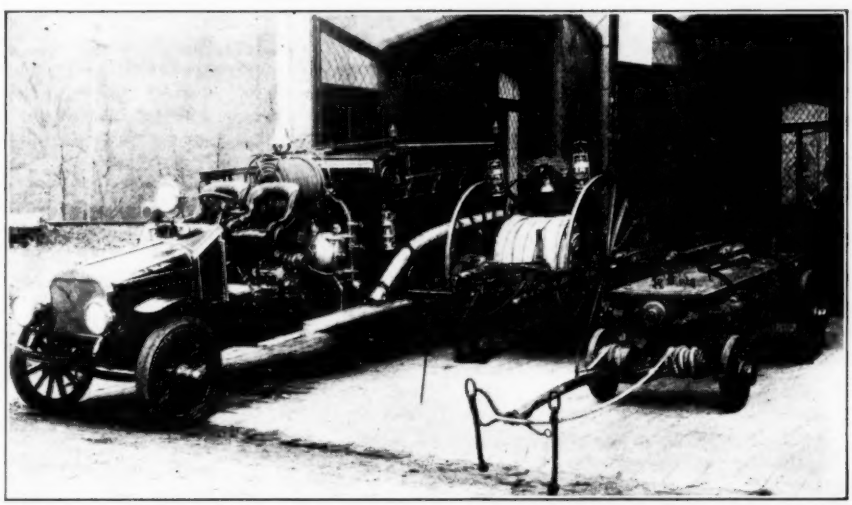
MURPHYSBORO PAVING BRICK COMPANY
Equal to the Best
"EGYPTIAN" BLOCK
Surpassed by None
MURPHYSBORO, ILLS.
PROMPT DELIVERIES. LET US QUOTE YOU PRICES.

BEST EXTENSIBLE TRENCHING BRACE MADE
KALAMAZOO F'DRY & MACHINE CO. MICHIGAN
594 EAST MAIN ST.

UVALDE
ASPHALT PAVING COMPANY
1 BROADWAY NEW YORK

MOTOR TRUCKS

Motor Trucks as Operated in Municipal and County Service and in Highway Transportation



CONTRAST BETWEEN OLD HAND PUMPING FIRE ENGINE AND MODERN MOTOR FIRE EQUIPMENT AT YANTIC, CONN.

Motor Truck Operation and Accounting LXXI

MOTOR TRUCK NEWS NOTES

Motorization of Street Department of Salt Lake City

The horse has been almost entirely supplanted by the gas driven motor in the street department of Salt Lake City, says T. T. Burton, commissioner. It is true that in some of the clean up work where frequent steps are necessary, the horse is still in use, but in nearly every other line of endeavor motor equipment is used. The use of the motor in street cleaning and road building shows a great saving in time, money and labor.

In the line of gas driven motor trucks used almost exclusively for the building of gravel roads the department has in use at the present time five 5-ton Packard trucks, four 5-ton and one 2-ton Federal trucks and one 5-ton Mack truck. The 5-ton trucks have a capacity of 4 cu. yds. per load. During the month of March, 9,312 cu. yds. of gravel were hauled from the pit and used for road building. On an average haul from the city's gravel plant this fleet of trucks can deposit on the road 341 cu. yds. of material every working day of 8 hours. The next in importance to the building of streets, sidewalks and sewers, is the keeping of these improvements in a clean, sanitary condition. In addition to the ordinary horse drawn sprinklers used mostly in the outlying districts to lay the dust, the department is equipped with one 1,200 gal. and one 1,000 gal. capacity steel constructed flusher tanks with automatic pressure pumps attached set on a 5½ ton and 3½ ton Federal chassis, respectively. These tanks under pressure will sprinkle the whole width of a 100 ft. street, each tank doing the work of five team drawn sprinklers and doing it better.

Nevada Public Service Commission Rules in Favor of Truck

"I was greatly impressed by a typical case recently heard before the Public Service Commission of Nevada," says H. P. Branstetter, Chicago Kissel distributor.

"It illustrates the superiority of truck transportation in economy, utility and speed of operation.

"Two Italian brothers who have been operating a small motor truck haulage company for some time, applied to the commission for a certificate of public convenience. The application was opposed by a short line railway company operating on the same route as that served by the Italians.

"The railroad had a strong moral argument. It was in possession of right-of-way, had been operating satisfactorily, and was paying considerable taxes. The investment in the railroad was very large. It was estimated that its scrap value was $450,000. It was argued that the addition of a competing carrier would depreciate its revenue and would result in poorer service and higher charges. The railroad claimed that the truck company could not operate all the year round. It asked that the truck company be compelled to adhere to tariff schedules, to be made to erect depots and be ordered to deposit bonds in the amount of $10,000.

"The two Italian brothers simply argued service. Their partnership owned a few high grade motor trucks. With them they covered a 50 mile route in 3½ hours, picking up and delivering freight at residences, farms, mines, warehouses and stores. Deliveries were direct. Railway freight shipments took as many days as the truck took hours. The truck service had actually been affected less by weather conditions than the railroad. A great many customers supported the statements of the brothers, saying that the service rendered was superior to that of the railroad and that a volume of local business was dependent on the truck haulage, and the commission ruled that the truck service was necessary to the agricultural, live stock, mining and commercial industries of the community."

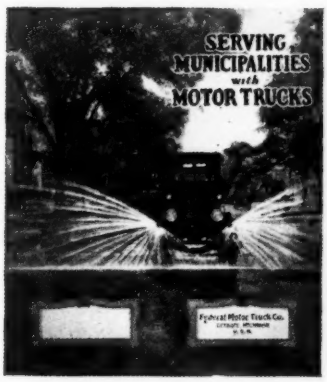
Assisting Truck Owners to Make More Money

It will surprise many truck owners to know that there are many agencies where co-operation, record of previous enterprises and statistics on motor truck operation may be obtained to assist them in making more money with their motor trucks, says Mr. M. L. Pulcher, vice-president and general manager of the Federal Motor Truck Company.

There are just three things that the best truck on earth could give you

They are powerful haulage service, daily dependability, and long life

Federal trucks give you all of these things for the least money



A genuine mine of suggestions for body equipment on Federals—for special purposes in municipal and county service—is contained in an attractive Federal folder "Serving Municipalities with Motor Trucks." The ideas presented may be invaluable in your work. Write for this folder. It will be mailed free on request.

FEDERAL MOTOR TRUCK COMPANY
35 Federal Ave., Detroit, Michigan

Another
FEDERAL
One to Seven Ton Capacities

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

The Department of Agriculture at Washington, the National Automobile Chamber of Commerce, 366 Madison avenue, New York City, the research department of the big tire companies, and the traffic engineers of most of the larger truck concerns, all have information and data which will be of benefit to those motor truck owners who are interested in forming inter-city lines for the haulage of more goods, both freight and express, and any rural motor express work.

In addition to the above available sources of information for the truck owner, there are the local chambers of commerce in almost every city of 25,000 or more in the United States, as well as the more recently formed local transportation associations in many of the larger cities. Bulletins of various kinds, booklets unnumbered, and cost figures without end, may be obtained from these sources, which will enable a man or firm to form motor truck lines which will be profitable and a source of great convenience to the shippers.

A recent bulletin by the Firestone Tire Company says "A healthful state of inter-city haulage will be brought about when the truck manufacturer, truck dealer and truck owner, function as one." They also say that one great source of satisfaction to the truck owner is co-operation among themselves.

While the above is surely true, yet we can truthfully say that the manufacturer has co-operated to no small extent in the past to help the truck owner so arrange his business that the small items are kept track of, to the end that the operator can make money. Many dealers throughout the United States, at least our own, have spent a great deal of time and thought on the development of these motor truck routes, and so we believe that the prospective truck owner, or those who already own trucks, can immediately find a source of information without looking very far, which will help him in the present plans of securing more haulage for his trucks.

A recent bulletin issued by the National Automobile Chamber of Commerce is entitled "Motor Transport Cuts Time and Cost of Shipping in New England"—another, "Good Roads and Motor Transportation"—still another, "Motor Trucks Save 45 Hours Per Shipment for Bay State Manufacturers," Bulletin No. 931 of the United States Department of Agriculture is entitled "Corn Belt Farmers' Experience With Motor Trucks." Ontario Department of Agriculture, Canada, has issued Bulletin No. 277, entitled "Motor Transportation in Rural Ontario." All of these booklets and many others may be obtained from the above sources, and will be most profitable to those who are interested in motor trucking.

Certainly one of the greatest jobs in food and factory production is transportation, and the world needs just as much food as it ever did, and much of that food to be marketed properly must be transported quickly. Motor trucks can do this job better than any other form of transportation.

Business is coming back slowly but surely, and an increasing number of motor truck routes are a necessity if we must continue economy in haulage. "Federal Motor Truck Company and their traffic engineers," concludes Mr. Pulcher, "are at the service of motor truck owners whether they are Federal owners or not. We welcome inquiries as to the operation of trucks in any line of business. We will be glad to give any advice or suggestions desired to anyone. Other motor truck manufacturers, we know, are like-minded. With the government agencies and the National Automobile Chamber of Commerce sources, it ought to be easy to make motor trucks pay today."

Road Contractors Gain Time by Systematic Use of Fleet of Trucks

On one 15-mile project, Johnson, Drake & Piper, Minneapolis, Minn., road contractors, poured 830 ft. of 18-ft. roadway in a day. On the same job, 600 ft. per day was the average maintained for two weeks, 4 miles being the average length of haul for materials. Several hundred lineal feet of roadway were poured daily while another job lasted.

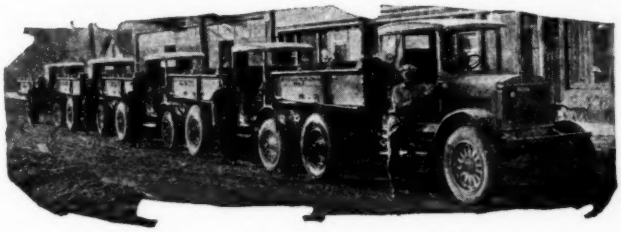
In each instance motor trucks were a big factor in enabling the contractors to accomplish the amount of work they did. Transportation of materials, Johnson, Drake & Piper consider, is one of the most important operations in road building. Therefore the care exercised to systematize this end of their work.

Six 2-ton, standard dump body White trucks were used on one project, calling for 3½ miles of new concrete highway. The trucks were operated by Day Bros., of Minneapolis, who held a sub-contract from Johnson, Drake & Piper.

The average haul from the central proportioning plant erected at the railroad siding was three miles. At the central proportioning plant a clam-shell derrick loaded cement, sand and rock into separate bins. From these bins the material was proportioned through chutes into

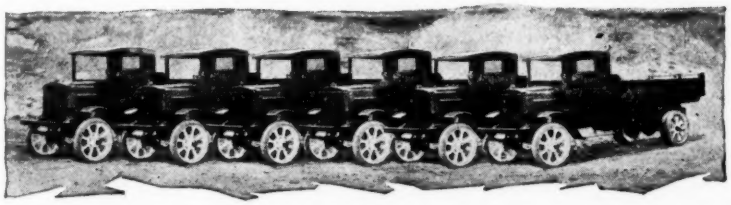
KISSEL
ROAD-BUILDERS' FLEETS

Fleet of special Kissel Road-Builders' trucks owned by C. F. Lytle, prominent Engineer and Contractor, Sioux City, Iowa.

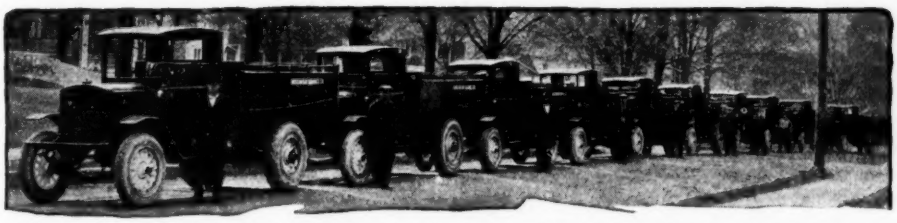


Fleet of special Kissel Road-Builders' trucks employed by Appleton Construction Company on Chilton-Hilbert (Wisc.) road contract.

Fleet of special Kissel Road-Builders' trucks employed by Gross Construction Company on Slinger (Wisc.) road contract.



Fleet of Kissel Heavy Duty Road-Builders' trucks owned by Washington County (Wisc.) Highway Dept.



Fleet of special Kissel Road-Builders' trucks employed by Ogara Construction Company on Hartland (Wisc.) road contract.

Properly designed, constructed and powered trucks—plus proper loading equipment and turning of trucks—plus proper supervision—insures highest efficiency and saves time and money for the contractor. The Kissel Engineers, in meeting contractors' requirements, have designed and developed Kissel road-builders' trucks and equipment to the maximum efficiency in saving of time, labor and money.

We will forward engineering data showing actual cost per batch to all contractors and road builders requesting same. Address

KISSEL MOTOR CAR CO., Hartford, Wis., U. S. A.

measuring boxes. By means of center gates, the truck boxes were divided into equal compartments.

In loading, each motor truck, stopping under the rock bin just long enough to shift gears, received two separate batches of rock in its twin compartments; moved ahead about 12 ft. and received two separate batches of sand simultaneously; moved forward once more to receive the proper amounts of cement from another pair of chutes; and then started on its way to the mixer, the complete loading operation having consumed not over two minutes.

Traversing a ¾-mile stretch of dirt road to reach the main highway, the trucks finally reached their destination at whatever point along the main road the mixer happened to be located. The next move, then, was to unload. Backing up to the skip with body in dumping position, the trucks emptied one compartment. When the skip had hoisted the batch into the mixer, the trucks in turn dumped the remainder of their loads and were some distance away before the last batches were hoisted.

Each truck made 23 to 25 trips between the central proportioning plant and mixer —an average three-mile haul—in a 10-hour day. Six White 2-ton trucks, supplying a three-sack mixer, facilitated the pouring of 700 lin. ft. of 18-ft. roadway, concrete 7 ins. thick.

A fleet of 12 White trucks were used on the 15-mile job on which 830 ft. of roadway were poured daily. The 2-ton motor units, with their narrow, compact bodies, horizontal hoists, speed and turning ability, were particularly adapted to road-building work, according to Day Bros. and Johnson, Drake & Piper.

Federal 5-Ton Truck Performs Task in 1 Day Formerly Done by 28 Mules in 3 Days

Ten years ago it took 28 mules 3 days to transport one of these immense boilers of the type shown herewith 5,000 ft. up in the Sierras to the Madera Sugar Pine Mills, 60 miles from Madera, California, the nearest railroad point. Recently a 5-ton Federal performed the same task in one day, despite the prophecies that it would never negotiate the steep mountain grades.

When Harvey Shuman, the operator of the truck system which keeps this isolated camp supplied with the necessities of life and machinery for its work, declared he could get this huge boiler up to the camp with his Federal he was laughed at.

The roads are full of dangerous winding turns, often attaining a grade of 20%, and several times it was necessary to chop down a fair-sized tree and drag it behind the truck as an additional brake.

In another place, the flume, or wooden trough, in which the logs are floated 60 miles down the mountainside to Madera, had to be cut to allow the truck to pass under with its huge load.

FEDERAL 5-TON TRUCK HAULING BOILER UP THE SIERRAS IN 1 DAY, A JOB FORMERLY REQUIRING 28 MULES AND 3 DAYS.

A fleet of four Federals running on the average of 20,000 miles each per year, is in continuous use to keep in supplies the 800 men in this mountain town. Regardless of weather conditions, they are on the road approximately eight months out of the year, bringing machinery for the mills, and mail, food and clothing for the men.

Famous Run Shows 20-Year Advance of Truck Design

Progress achieved in a decade of motor truck manufacture was demonstrated dramatically on May 28, 1921, by the Pierce-Arrow Motor Car Company, of Buffalo, when the historic New York to Boston run made in 1911 by America's first worm-drive truck was repeated.

The identical truck which made the run in 1911, known as Pierce-Arrow truck No. 1, covered the route again. It was accompanied this time, however, by the latest product of the Pierce-Arrow Company, a Dual Valve 5-ton unit.

Although more than ten years old and with 175,000 miles of daily service to its credit, the veteran clipped two hours and 20 minutes from the 20-hour record made

When You Buy a Motor Truck

Select it with care for
It makes a difference (*to you*)

what truck you buy. Your truck should be selected to suit the character of work you expect it to perform.

You would not think of buying a pump in the open market without first satisfying yourself that you are selecting the right type and size to handle your pumping job, and you should not buy a motor truck, at random, without giving careful consideration to the size, type and other features it should have to meet satisfactorily the conditions under which you expect to operate it.

There are over 200 makes of trucks on the market. Any truck manufacturer will take your order, of course, but only a small percentage of all truck manufacturers have made a special study of the trucking requirements of cities, counties, road builders and public works contractors.

These special studies have resulted in up to date, competent motor truck engineering which determines the proper size of truck and the proper truck equipment for solving the various hauling problems of cities, counties, contractors and road builders.

This magazine has published a special Motor Truck Section in every issue for **six years** and has studied carefully the trucking problems of this field and the trucks that best solve those problems.

If in the market for trucks let us know your requirements and we shall be pleased to give you the benefit of expert advice.

Municipal and County Engineering

702 Wulsin Building **Indianapolis, Indiana**

ten years before. But the old-timer was no match for its modern brother, which made the 240-mile journey in 14 hours and 43 minutes, its engine governed to normal speed.

"Truck No. 1 performed just as its makers designed it to perform ten years ago," said Robert O. Patten, truck sales manager of the Pierce-Arrow Motor Car Company. "Old as it is, the truck fulfilled the speed, load-carrying and endurance specifications which it originally was designed to meet.

"But the record of the Dual-Valve truck presents a contrast which shows strikingly the advance of manufacture and design. The most powerful truck engine built carried the 5-ton load over the road in three hours' less time. High-gear speed on hills, even greater coasting ability and a faster normal speed told against the surprising performance of the veteran.

"Ease of control and driver-comfort were factors that counted in the test. Harry Ward, who, by the way, drove Truck No. 1 on its 1911 test, did not find it excessively fatiguing to make the New York-Boston run in the Dual-Valve model in one day, despite the fact that he now is not accustomed to steady truck driving. He left New York at dawn and not long after dark the same day he arrived in Boston.

"The old-time truck, which does not have the electric-lighting equipment now standard with Pierce-Arrow, remained over night in Worcester, arriving in Boston the following morning.

"Thus, to the qualities of durability and reliability, for which Pierce-Arrow always has been noted, we have added more power, greater speed, and greater utility."

Truck No. 1 is historic in automotive history. It is one of the famous "first fifty" group of Pierce-Arrow trucks, 48 of which outlasted nine years of service. Its tenth anniversary run between New York and Boston, which it just made, was not the first occasion on which it repeated its 1911 performance. It also made the run on its seventh anniversary in 1918, running fully loaded with its tool box sealed.

The veteran is privately owned by a Buffalo firm and has been returned to them for added years of active service.

Federal Announces New 5 to 6-Ton Truck

The new 5-6 ton model truck announced recently by the Federal Motor Truck Company of Detroit, Michigan, possesses a number of new and distinctive features, according to a statement made by M. L. Pulcher, vice-president and general manager of the company.

According to Mr. Pulcher, this new heavy model, which has been produced after many months of experimental and actual road test work, was brought out for the express purpose of meeting several demands of the heavy haulage business which have developed in the past few years. The first is a continually growing demand for a truck with sufficient power to pull itself out of the most difficult places, excavations, pits, bad roads, etc., with its full capacity load; and the second is for a greater road speed under full load than has heretofore been possible with the average full loaded heavy duty truck.

Among the features of this new model is the new 50-H. P. Continental motor, which was made especially for this model and in accordance with the designs and specifications of Federal engineers. By means of this motor the truck is able to attain an unusual speed on the road, and the manufacturers claim for it that they have never yet, in all their operating tests, been able to place the truck in a position where they could not spin its drive wheels, so powerful is its engine.

Trucks Battle Colorado Flood

Many harrowing tales have come out of the flooded areas of Colorado, telling of superhuman efforts that successfully combated the devastating elements. An incident that demonstrates the dependability of motor trucks meeting emergencies, is told in a letter received by Harry P. Branstetter, Chicago Kissel distributor.

This letter was written by John T. Garver, manager of the Turner Moving & Storage Company of Denver, who have employed Kissel trucks for four years, starting with five models and now owning a fleet of 22 Kissels.

A great deal of the Turner haulage business is in transporting furniture and household goods over the mountains from one city to another, with an average distance of 100 to 150 miles. Mr. Garver's story starts in the flooded district, Friday, June 3rd:

"When the storm broke, we had two trucks at Central City bringing loads to Denver. After getting within 10 miles of Denver, the water was so high that our 1½ ton loaded truck was picked up and landed against a fence. Our 2½ ton Kissel Freighter had 5,500 lbs. on, but the driver didn't hesitate to go to the assistance of the smaller truck that was in

trouble, put the chains on and pulled it out. Now, When I tell you there was 4 ft. of hail that had fallen besides the water, I am telling you facts. The water got so high that the drivers had to take the trucks back to Lafayette, passing trucks of all makes that couldn't make the grade.

On Saturday, I took the drivers of the two trucks and went up to bring them in, if it was possible, as they were loaded with furniture and stood a chance of being damaged.

We had to come back over a makeshift road. When we got to one-half a mile of Clear Creek, on what is called the Picos Street Road, we met five trucks trying to climb the hill. There was a 2 ton truck of a prominent make in the lead, a 2½ ton Kissel behind it and another 2 ton truck behind the Kissel. The truck ahead was buried clean down to the differential. The Kissel truck had 4,500 lbs. on; the truck in the lead had a 4,000 lb. load on and the truck that the Kissel was dragging had on 4,000 lbs.

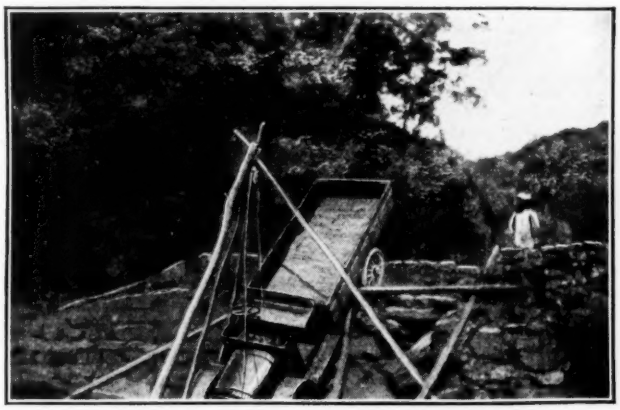
While the Kissel was dragging the truck behind with chains, it didn't hesitate to put the bumper against the back end of the truck ahead and got the whole three trucks with a combined load of 12,500 lbs. up over the hill.

Now, this doesn't seem reasonble, but it beat anything I ever saw. I would make an oath that this was true. We brought both Kissels into Denver that day without any trouble whatever, except at bridges that were very dangerous to cross."

Truck Falls 15 ft. Without Damage

During a trip through a rough mountain pass in the Kodaikanal Hills of Southern India a motor truck carrying two and one-half tons of baggage and eight passengers plunged over a fifteen-foot embankment to the rocks below. By some miracle no one was injured. Equally remarkable was the achievement of the truck, a Garford, which when lifted to the road again, three days later, was found to be undamaged and continued its trip to Kodaikanal without so much as a dusting off.

The town of Kodaikanal is 7,500 ft. above sea level and is reached by twenty-five miles of very picturesque but steep and rocky roads. A fleet of Garford trucks is employed in the operation of a regular passenger and mail service through this difficult and mountainous territory.



GARFORD TRUCK BEING HOISTED BACK TO ROAD AFTER 15-FT PLUNGE OVER EMBANKMENT AT KODAIKANL, INDIA. THE TRUCK WAS NOT DAMAGED.

The accompanying cut shows the truck being lifted to the road by an improvised derrick following the accident.

Assisting the Truck Buyer

The attention of the reader is called to the publisher's announcement on page 17 of this issue. As stated, our long study of the motor trucking problems of cities, counties, public works contractors and road-builders, and our equally long study of the types and sizes of motor equipment best calculated to solve those problems economically and successfully, enables us to render a distinctly helpful advisory service to readers who are now, or expect to be, in the market for motor trucks. This service will be rendered free of charge to workers in this field.

Advertising and Construction

Is there an Actual and Definite Relation Between the Two?

(Reprinted from "A Relation Between Advertising and Construction," by Harold K. Ferguson, President, The H. K. Ferguson Co., Engineers and Builders, Cleveland, Ohio.)

In a period covering many years of active personal effort in the engineering and construction business—particularly in the industrial field—one fact has recurred with such increasing regularity that it repeatedly compelled my attention.

From my first entry into construction, I found myself, time after time, dealing with concerns whose names are household words from coast to coast because of their continued and aggressive use of advertising. There have been times, in fact, when my business activities have been almost exclusively confined to such concerns.

The first result of this rubbing elbows with advertisers was one which is typical of human nature.

I imitated them.

At a time when almost every step was pure pioneering, with little or no precedent to guide me, it induced me to apply advertising to the sales-problems of engineering and contracting. It was the unswerving faith in advertising displayed by these notable advertisers, which convinced me that it was and is a force far more generally applicable to all business problems than the majority of my own associates then believed. Without conscious effort on their part, my customers unknowingly "sold" me on advertising and sold me sufficiently to induce me to make what my friends then believed to be a rash gamble.

At first this was the sole result of my contact with advertisers, as I did not then sense the full scope of the fact upon which I had stumbled.

The second step in my own advertising education came when I awoke to the fact that my past dealings with individual advertisers were merely an indication of the future. National advertisers, I found, could not build one plant for all time but were continually reappearing in my prospect file. It became increasingly self-evident that one of my biggest markets promised always to remain among my past customers of this national advertising group. Each succeeding year disclosed them to be the concerns most frequently in need of increased floor-space. Acting upon this discovery, I took precautions to urge each sales-representative to call upon every national advertiser in his territory.

The actual incident which led to this booklet, however, was the recent publication of the statement that 80 per cent. of all business failures in 1920 were of non-advertising concerns.

The emphatic nature of that percentage convinced me that it would prove worth-while to tabulate and check up my own experiences to discover whether a parallel truth was concealed in them. The figures thus obtained went far beyond even my own expectations in the degree to which they compel recognition of the power of advertising.

Selecting for convenience the first one-hundred factory contracts of The H. K. Ferguson Company, a detailed analysis, name by name, disclosed so definite a relation between advertising and construction that they seemed to me to demand publication. The figures, when listed and verified, analyzed as follows:

Total Contracts Listed		100
Advertisers	67	
Non-Advertisers	13	
		80
New Companies	15	
Local Business Only	5	
		20

When, for our present purpose, new companies not in production and those companies with only a local field of operation are excluded, the statistics, stated in percentages, become so pointed in their teachings that they merit the attention of any business executive who seeks to sell his product over a wide area.

Out of this "first hundred" the total number of firms building factories for the increased production of products to be sold on a nation-wide basis is 80.

The greatest single group in this 80 is that of **national** advertisers—i. e., those who advertise in magazines of general circulation to extend the sale of their product.

Out of the total operating on a nation-wide basis 48¾ per cent. are national advertisers.

Of the firms ordering **more than one** Ferguson factory in this period, there was only one outside of this national-advertising group.

Closely allied with this group are the firms whose advertising message, because of individual determining factors, is permanently or temporarily limited to those publications of selective circulation which are commonly known as class publications.

Taking the sum of these two advertising groups, we find that 83¾ per cent. of all Ferguson factories are erected for concerns which advertise.

The emphatic character of this percentage is further substantiated by the fact that the floor space furnished to advertisers totaled 2,423,000 sq. ft. as compared with 193,000 sq. ft. purchased for the production of non-advertised commodities (new concerns or manufacturers with local markets not being included in these figures).

The three figures thus separately secured, all agree convincingly as to the power of advertising.

Eighty-four per cent. of all business failures are non-advertisers.

Eighty-three and three-fourths per cent. of all Ferguson factories are purchased by advertisers.

Ninety-two and six-tenths per cent. of the total new floor space was required for the increased production of advertised commodities—or something more than twelve times the space purchased by non-advertisers.

Stated differently, the figures indicate that the manufacturer who advertises is five times as likely to stay in business as his non-advertising competitor, and is five times as likely to need more factory space which he will probably buy in two and one-half times the quantity required by the non-advertiser.

The lesson is so obvious that I believe it needs no enlargement or emphasis.

EDITORIALS

GREAT IS THE CONSTRUCTION INDUSTRY

It is a pleasure to note the appearance of a special bulletin on The Construction Industry issued recently by the U. S. Chamber of Commerce and reviewed briefly in this issue. That the construction industry has not been properly appreciated in the past was only too well demonstrated during the war period when so many obstacles were thrown in the way of workers in this field by officers of the federal government who classed construction among the nonessentials along with musical instruments and others of the frivolities and superfluities of life. It is distinctly pleasing, therefore, even at this late date to have the construction industry rated as a basic industry of prime importance by such an unbiased and competent authority as the U. S. Chamber of Commerce.

It is suggested that readers obtain copies of the special bulletin for preservation and use. Presumably this can be done by addressing the headquarters of the Chamber at Washington.

The bulletin provides a very exceptional opportunity for individual workers in the construction field to do some publicity work for the benefit of the entire industry. While we appreciate that our readers are not dependent on others for ideas or suggestions we believe they will receive from us the suggestion that it is highly advisable to make the facts set forth in the bulletin the subject matter of letters to newspaper editors on the extent and importance of the construction industry. Quite likely newspapers will publish editorials on this subject, also, if the information contained in the bulletin is brought to the attention of the editors. Such publicity is greatly needed by the industry and the opportunity to secure it is now readily at hand.

Some of the figures given in the bulletin are quoted in the brief summary published in this issue and reference is made to that summary for facts and figures. The impression made on the Chamber by its study of the industry is indicated by certain sentences here selected for quotation from the bulletin:

"Next to Agriculture the Construction Industry ranks beside the largest of the remaining groups."

"It is apparent that the classification 'Trade' must look to the prosperity of the Construction Industry for a large proportion of its business."

"Construction is a prerequisite to wealth accumulation and it is only by this means that the immense resources of this country are made available for everyday use. Progress is measured in terms of man's growing ability to overcome the forces of nature and to subject them to his will. It is because construction devices are brought into full play that a happier lot ultimately results for the human race."

"An industry that absorbs three-fifths of the proceeds from new financing and about half of the country's annual accumulations of capital, automatically places itself foremost in order of importance and deserves recognition as one of the most potent forces that shape our economic life."

"Public construction, such as streets, highways, sewers, etc., that has been postponed for a considerable length of time because of the prohibitive outlay involved at inflated levels, is again undertaken, and gradually the movement extends to home and office building, as investments become more profitable through lower costs. Construction reopens the trail and other industries slowly follow along the path. Gradually business recovers and the cycle begins anew."

"Thus Construction would seem to be the barometer of our industrial life. When depression strikes Construction it rocks the entire industrial structure and 'good times' undergo a process of metamorphosis which is conducive to acute conditions. But when the tide turns, Construction is the first to be carried with the rising flood, and other industries follow in its wake. It is, therefore, desirable that a better understanding of the Construction Industry and of general conditions surrounding it be had at the earliest possible moment, to form the groundwork upon which nation-wide industrial conditions may be stabilized."

While the fundamentals thus quoted are entirely familiar to our readers it is gratifying and helpful to have them appreciated by the U. S. Chamber of Commerce. Let us reveal this discovery of our industry to the public, especially to our solid but conservative friend the banker.

HIGHWAY PAVEMENT EDGING

Attention is called to the fact, by a writer in this issue, that: "A 12-in. bituminous macadam edging on each side of a brick pavement laid upon a rolled stone base furnishes a means of waterproofing the berm adjacent to the pavement and to widen the roadway. Vehicle traffic in getting on and off the berm in wet weather, due to insufficient width of pavement to permit two lines of traffic, will form ruts or grooves that permit the infiltration of water into the subgrade and artificial base. This type of edging also affords vehicles an easy approach from the berm to the pavement, as compared to a rigid curb or edging. The cost of maintaining this type of edging is an item to be considered, but its merit for the pavement design under consideration would appear to justify a small maintenance charge."

We are glad to endorse this suggested feature of design, for its advantages have been observed frequently in driving over narrow pavements of various types on country roads. With a properly formed shoulder of ample width and properly surfaced, a comparatively narrow roadway will serve two lines of traffic satisfactorily in many localities. If the pavement is so narrow that, in passing, the outer wheels of vehicles are forced to leave the pavement then the presence of a well-formed shoulder becomes essential to the satisfactory performance of the road. If, in leaving the pavement, vehicle wheels drop off into the mud the usefulness of the pavement is immediately lessened.

It is recommended, therefore, that in all cases where narrow pavements are used that some sort of gravel or macadam shoulders be provided and maintained to develop to the fullest extent the usefulness of the narrow paved roadway.

THE ULTIMATE GASP IN DETOURS

We have had occasion to remark before that "any discussion of present-day practice in laying out, marking and maintaining highway detours becomes an elaboration of the obvious, for it is the partial or complete failure to do what very obviously should be done with respect to detours that makes this a subject worthy of discussion."

Perhaps we have demonstrated the truth of the statement quoted, but if not we offer the following illustration by way of a clincher: Obviously after a road has been reopened to traffic and the detour abandoned the detour signs should be taken down. It is not expected that any sane adult will question this elemental truth. Yet we have the word of a man who has had much experience in country driving that on the first day of the present month in driving on a famous highway in a central state he came upon detour signs and followed them only to learn afterward that the main road was open to traffic and someone had neglected to take down the detour signs. True the barricade had been removed, but it does not require a horse-high, bull-strong and hog-tight barricade to turn a motorist of decent impulses off the highway; such a man respects an official detour sign, and, in this case, was penalized for observing the rule of the road.

Some of our readers may wonder why we consider the subject of detours of sufficient importance to discuss it editorially in three consecutive issues. Our observations on the subject have been quite impersonal; an effort has been made to present the viewpoint of the public by way of calling attention to a source of danger to the better highways movement.

When certain politicians, years ago, sensed the popular dislike of the railroads they launched one attack after another against them and the railways have not recovered from such attacks to this day. The railway employees in direct contact with the public were so uniformly discourteous, oftentimes to the point of insolence, that the public generally gradually became hostile, not only to the grouchy ticket seller and to the brass-bound and imperious individual who collected tickets, but to everybody and everything connected with the railroads.

It did not pay the railways to irritate the traveling public and it will not be well for the highway movement if the convenience of the public is set at naught in respect to detour practice. If other forms of transportation decide to wage war on highway transportation their battle will be half won before they strike a blow if a large section of the public has been turned against the highways as a result of avoidable pin-pricking irritations of one sort or another experienced in highway travel. Perhaps it is scarcely in true proportion to suggest that detours register as pin pricks, for many detours produce an effect on the motorist that is not unlike that of a series of wallops administered with a bed slat.

And that's that.

MOVEMENT TO AWARD ROAD CONTRACTS IN FALL INSTEAD OF SPRING

The following letter from Stanley D. Moore, of the Moore-Young Construction Co., Waterloo, Iowa, chairman of the Highway Division of the Associated General Contractors, to W. R. Neel, Atlanta, State Highway Engineer of Georgia, and chairman of the Conference Committee of the American Association of State Highway Officials, is self-explanatory. The subject of fall lettings of highway contracts is of great importance to all contractors, engineers, public officials and, of course, the general public. The policy advocated will cut down the lost time in each year from 6 months to 3 months: Mr. Moore's letter follows:

"I have just received from our Executive Board the necessary sanction for the promulgation of a policy that will require your quick and hearty co-operation, if it meets with your approval, together with that of the National Association of Railway Executives, National Coal Association, National Sand and Gravel Producers Association, and several other associations that are either directly interested in construction projects or are users of open-top railway equipment.

"There has already been some correspondence with individual members of some of these interests.

"Briefly, the idea is to change the custom which is just starting of letting highway contracts in the spring to a general plan of making such awards in September and October, particularly in the northern section of the country. The reasons are, of course, obvious to you, but in order to save your time I will review some of the arguments in support of the proposition.

The Peak Months

"1. There has been in the past and will be in the future, to a greatly increased degree, an acute shortage of open-top equipment during the months of September, October, and November, these being the three months during which the coal begins to move and being also the peak of the aggregate movement for highway and other large construction projects.

Storage and Unloading

"2. The closing of the contracts in the fall would enable the contractor to perfect his organization and arrange for his storage and unloading during the idle winter months, thus permitting the early movement of aggregate during March, April, May, and June before the coal starts.

Movement of Cement

"3. The same argument applies to the movement of cement in box cars before the grain movement begins, and to new contractors' equipment, the sale, production, and shipment of which is now crowded into May, June, and July.

Spreading Peak Load

"4. Instead of the maintenance of expensive lobbies and committees in Washington trying to get preferential rulings out of the Interstate Commerce Commission and generally quarreling over the car supply, a little co-operation along this line will have the effect of spreading the peak load and fundamentally removing the cause of the trouble. The ramifications of this feature are too many to cover in this short outline.

Production and Overhead

"5. From a contractor's standpoint, and reflected therefrom directly to the public in decreased cost of roads, it is obvious that any policy that will have a tendency to increase the possible number of days during which he can operate, will enable him to spread his fixed overhead over a greater production. For instance, on jobs where industrial track equipment is used, if the contractor can get enough grading ahead during the late fall and some track placed, there are probably 25 days between March 15 and May 15 on which he could lay concrete, but which would not be dry enough for organized grading operations. There are many road jobs which are truck propositions on which stock piles can be built before the frost goes out of the ground, enabling some operation in the early months that would otherwise be impossible.

Low-priced Roads

"6. To sum up the factors entering into this phase of the problem, it is only necessary to say that the goal of low-priced roads will be reached only by the route of increased production, and anything that is done to increase the output per unit, and spread the production over a longer period of time per year, will result in decreased cost of cement, aggregate, transportation, contractors' and supervising services.

Suggestions Desired

"If this thought appeals to you as it does to me, as being a really constructive move in the direction of solving one of our basic difficulties and well worthy of the associated efforts of everyone involved, I would like to have your sugges-

tions as to how we can go about getting the idea before the necessary authorities in time to get it into partial operation before next year. While the situation will be there for us to work on the year after and for some time to come, it appears as though next summer would be the worst, and something might yet be accomplished this summer without waiting for the winter conventions."

SEWAGE TANKS AGAIN

By W. G. Kirchoffer, Sanitary and Hydraulic Engineer, 22 N. Carroll St., Madison, Wis.

In my previous discussions of this subject I have purposely avoided a statement or opinion of what I thought or expected the bacteriological or chemical action would be in any tank. But since Mr. G. Everett Hill has so kindly requested me through the columns of Municipal and County Engineering to discuss his views in the matters, which touch upon this phase of the subject, I will have to digress from my former purpose and enter into, to a limited extent, a discussion of this phase of the subject.

All that Mr. Hill says is of much interest and adds to our store of knowledge of this subject. I certainly appreciate his kindly comments on my type of tank. As to my views on the two story tank referred to in the February issue, those statements were made in answer to Mr. Coulter's communication and were made for the purpose of making it clear that I thought the slots over the first section of the lower chamber essential, as compared with his contentions that they were not essential in all installations of two story tanks. I have found in my experience, and I think that others working along similar lines will agree, that no type of tank, no matter how well designed, will work equally well on all sewages nor will any one type of tank give satisfactory results all of the time on the same sewage.

For illustration, a few years ago I was called upon to design a sewerage system for a small town in Wisconsin. The city officials had visited a neighboring town where a few years before a septic tank had been built. They were much impressed with the results that were being had with this tank. "The effluent was clear as water," they said. However, had they visited the tank three or four years later they would have been much impressed the other way. A state official of the Health Department was called upon to visit the town to remedy the nuisance the tank was creating. He asked me if I had seen it, said it was the worst nuisance he had ever seen from a tank.

In another case I converted an Imhoff tank into a modified "Kirdorthoff" tank. It worked fine until the combination of the waste from a woolen mill and a creamery destroyed its effectiveness.

Both of these tanks may have housed aerobic or anaerobic bacteria and possibly the conditions for their development at times may have been ideal, but time proved that conditions arose which produced effluents which were not up to the standard required for those localities. From observations made upon the tanks at Madison, Wis., over a period of four months, I would venture the opinion that the trouble with the first tank was that the bacteria produced enzymes in which they could not live and the tank was so constructed as to confine those by-products in the flowing current in the tanks. I doubt if any of us can say with assurance just what is going to take place in any tank we propose to design and install. I have designed a few Imhoff tanks that are giving fairly good results and are satisfactory to my clients, whereas others have proven failures. I am quite positive that the character of the waste, its state of freshness, be the difference ever so small, and any mechanical disturbance, such as pumping, greatly affects the results attained over a considerable period of time.

I believe that the chemical quality of the water supply of cities greatly affects the character of the sewage and the eventual results obtained. A water supply known to be high in sulphates produced a sewage that when detained in a septic tank gave off vile odors of hydrogen sulphide. It is well known in some localities that residential septic tanks give satisfactory effluents, whereas a municipal plant in the same city is a failure. The difference must lie in the difference in the character of the sewage which hinders or accelerates the growth of certain bacteria and not wholly in the design of the tank.

Mr. Hill's tank with flaring sides, as he says, will give satisfactory results. He has proved it, but can he guarantee that if he should install it where conditions have arisen, where other types of tanks have failed to produce the desired results, that it would give a satisfactory effluent?

I can scarcely agree with him that the slight difference in width of tank which

would reduce the velocity about 2 to 3 in ratio would prove a means of sorting out food for different kinds of bacteria. It is possible that a plain box type septic tank would have given equally good results for an equal length of time.

I hardly approve of the inlet device of Mr. Hill's. I have found that too many small channels, crooks and turns in the inlet, where all of the coarser matter was present, tended to clogging, with the result that the sewage generally entered in a manner just contrary to the way we expected it to. In the smaller tanks a simple tee or ell looking down into the tank, or, in larger tanks a fairly deep baffle, will be found to give good results over a long period of time. If, as Mr. Hill says, it is a good principle to make the outlet end of the tank wide, why not make the tank circular, fairly shallow, but large in diameter with the inlet in the center, so that we would get a very large reduction in velocity without getting an extremely long rest period?

I cannot see wherein his tank is really comparable with my type as to the separation of the sludge and acum from the liquid portion. I think we can safely venture the statement on the theory of operation of the bacteria that any variety will kill themselves with their own enzymes if there is no provision made for carrying them away as fast as made and at the same time supplying more food from products which are not detrimental to bacterial life. An excessive use of a disinfectant in a sanitarium made the buildings and fixtures sanitary, but it stopped bacterial action in the disposal plant which caused the tanks to fill with sludge and the filters to clog.

I claim that the Kirdorthoff tank has the feature which tends to remove enzymes (bacterial poisons) and to supply the bacteria with fresh food and at the same time not disturb the contents of the tank to such an extent that sludge in a finely divided state, or otherwise, will be carried out of the tank. I fail to see how a single story tank, however designed, can accomplish both of these functions. Although I believe where tank treatment is necessary it will be found that the Kirdorthoff tank is a great improvement on other types of tanks, I am a believer in the idea that for the larger plants and for those treating industrial waste that we must resort to mechanical means as an aid to purification.

I have convinced myself, if not others, that the septic, Imhoff, or Kirdorthoff type of tank, is not suited to the treatment of a combination of creamery and woolen mill waste. These two wastes contain so much oil, grease and casein that the functions usually performed by tank action, sedimentation, bacterial and chemical action are almost entirely stopped and in some cases reversed.

The Dorr Co. has demonstrated quite conclusively, in some instances at least, that mechanical devices aid materially in the reduction of sludge and the purification of the effluent.

The sooner we all come to the conclusion that the universal purification of sewage by tank treatment is all a myth the sooner we will all get down to the real business of sewage purification. The notion that the septic tank was an absolutely sure method of sewage purification became so firmly fixed in the minds of the people that it is now hard to convince them that it is not in all cases a cure-all for the ills of sewage pollution. Only recently a college professor, editor of a college agricultural paper, told me with a great deal of firmness and expression of superior knowledge that there was no better tank for the purification of sewage than the septic tank. I believe that compressed air and mechanical devices such as screens, paddles, etc., are going to be the coming devices in sewage disposal.

At the Madison plant three years ago I raised the stability of the tank effluent from zero to 30 in two days of operation of a very simple air lift pump used to circulate the sludge. In sewage filtration we aim to oxidize the effluent, but in tank treatment we deoxidize it. Why not take the fresh sewage and start the process of oxidization at once instead of delaying it through the usual form of tank treatment?

Where financial or other considerations will not permit the installation of plants involving mechanical operation and constant attention, then we should select such a type of tank that will give the best results, in our judgment, and be within the means of the client, whether it be a Hill tank with flaring sides or a Kirdorthoff tank, or some other type should govern the selection. The inexperienced often say, "This tank is going to do so and so and the results will be ideal, etc.," but experience teaches a different lesson. If one is designing a tank on pure assumption, he would better leave it out and spread the sewage out on mother earth, where it surely will, in time, be purified.

CLAY PRODUCTS RESEARCH WORK LAUNCHED

Representatives of four national associations of manufacturers of burned clay products, namely, The American Face Brick Association, The Common Brick Manufacturers' Association, The Hollow Building Tile Association and The National Paving Brick Manufacturers' Association, together with the secretaries of these associations, representatives of the Federal Government, universities, and the American Ceramic Society, met in Chicago on June 16, 1921, to perfect an organization through which the cooperation of the Associations might be made effective in clay products research.

The Technical Committee reported a plan of research which was approved by the Executive Committee on behalf of the four associations. The plan follows:

The work will be divided into two parts. (1) Dealing with the study and investigation of commercial kilns, represented by the up-draft and the down-draft kilns, the continuous kiln of the straight tunnel type, the compartment continuous kiln, and the tunnel car kiln. (2) Dealing with the study of the water-smoking and dehydration process, by the Bureau of Standards, the study of heat absorption throughout all the burning stages by the Ceramic Department of the University of Illinois, the study of oxidation and vitrification stages by the Bureau of Mines, and experiments in the study of combustion and transmission of heat, in a semi-commercial kiln, by the Bureau of Mines at Columbus.

The first part will constitute by far the most extensive part of the program and will involve the detailed study of the different types of kilns, not only from the standpoint of fuel consumption but particularly with reference to the rise of temperature throughout the kiln and the actual rates of water smoking, oxidation and vitrification.

It is proposed to study also the draft conditions, the combustion as taking place in different types of furnaces, the various heat losses, and the influence of the kiln, flue and stack dimensions upon the burning process.

It is proposed that the Bureau of Mines send out well-trained experts to conduct this work at representative plants, selected for the purpose with special reference to securing a certain degree of freedom of action. By this is meant permission to be granted to make such burning changes as are apparent from the results obtained and to make notes of the effect of such changes. A complete study will be reported of each kiln examined, drawing from the observations made, all conclusions warranted by the facts.

In addition, a questionnaire will be sent out by the committee to the industries concerned, by means of which it is expected to obtain a certain amount of information which will help in drawing general conclusions.

All of this information will be collected and treated from the standpoint not hitherto presented to the industries. It is expected to present the information collected by means of definite statements or definite recommendations in language that can be understood by all.

The laboratory studies to be conducted at the Bureau of Standards and the University of Illinois are intended to furnish information concerning the methods of attack and the fundamental principles involved in the burning process and thus will supplement the kiln studies.

In those investigations all purely theoretical features have been eliminated and only such work will be done as will throw direct light upon the phenomena involved in the burning process.

Of particular interest will be the tests conducted on the semi-commercial kiln to be erected by the Bureau of Mines at Columbus. In this kiln all the factors entering into combustion will be under control, such as the volume of air used for combustion, the intensity of the draft, the maximum and exit temperatures, and the rate at which the heat is transmitted to the ware. Thus it is expected to determine the effect of heavy or light fuel beds, the effect of long flame versus short flame coal, and other factors.

It is to be noted, therefore, that the investigations will proceed along broad and comprehensive lines, and it is to be expected that the results will prove of interest and value to all of the ceramic industries.

It is perhaps not too much to say that some of the results that may be expected will be of a more fundamental character than it is possible to realize at the present time. It has always been the experience of such comprehensive investigations that many by-products, in the shape of important results that cannot be foreseen in the beginning, are obtained.

The Chairman of the Joint Research Committee is Mr. F. W. Butterworth, Western Brick Co., Danville, Ill., and the Secretary-Treasurer is Mr. Maurice B.

Greenough, 830 Engineers Bldg., Cleveland, Ohio.

CONSTRUCTION ANALYZED AND RATED AS BASIC INDUSTRY BY U. S. CHAMBER OF COMMERCE

In a special report issued June 17th by the Committee on Statistics and Standards of the United States Chamber of Commerce, of which A. W. Douglas of St. Louis is chairman, the total national wealth of the United States is estimated at $288,464,000,000, of which $77,321,000,000 or 26.8% is represented by the Construction Industry. The report presents an analysis of the relationship of construction to the basic industries of the nation, including manufacturing, mining, transportation, agriculture, trade and finance, and concludes that construction as a key industry should be classified separately as one of the nation's basic industries.

25 Per Cent of Manufacturing for Construction

The report shows that in 1914 one-quarter of the 276,000 manufacturing concerns employing 10,658,000 workers, with an annual payroll of $5,368,294,000 and an annual output worth $25,000,000,000, was devoted to construction products.

In 1920 90 per cent of all iron ore, copper and zinc, and 95 per cent of all lead mined was consumed by construction. Twenty per cent of the bituminous coal and five per cent of the anthracite coal mined was used by manufacturers of construction materials, by the railroads in transporting these products, and by traction lines and public service corporations in service to construction workers. A rough estimate of the value of these minerals is $4,400,000,000, engaging more than 1,000,000 workers at an annual wage of approximately $1,000,000,000.

Twenty-five per cent of the freight transported by the railroads is construction materials.

Eleven Millions Depend on Construction

Fully 11,000,000 persons, either as workers or as members of workers' families, are estimated to derive their living from construction, either directly or through manufacturing and mining products used in the Construction Industry. The support given to agriculture and to trade by the annual expenditures of this great number of persons is estimated at more than $5,000,000,000 for rent, fuel, food, clothing, furnishings, recreation, etc.

Half of New Capital Issues for Construction

New capital issues during 1920, so far as reported, totaled $4,545,000,000, consisting of state, municipal, railroad and industrial securities, of which it is estimated 50% were issued for construction in one form or another. A considerable portion of the new capitalization went to pay off maturing obligations, which were reflected, however, in past construction to a large extent.

Even this estimate does not cover the whole field. It excludes indebtedness of the Federal Government for construction, for which segregation is difficult, and does not include issues of foreign governments or municipalities in this country, the proceeds of which were to be used for improvement and extension of their public undertakings. This sum also is short a huge amount of expenditure for new construction because a great amount of expenditures for additions to plant, structures, etc., is paid out of earnings and surplus and does not figure in the investment market. With all these figures at hand it appears that 24% of the year's capital accumulations, and probably 50% of the national savings annually go to construction.

Construction—A Basic Industry

Based on this analysis, the report concludes that the Construction Industry is an unique barometer of the state of business in all industry and as such deserves a separate classification among the basic industries of the nation on a par with Agriculture, Mining, Manufacturing, Transportation and Communication, Commerce and Finance.

EFFICIENCY OF DIFFERENT TYPES OF CAR-STOP SAFETY ZONES

(Editor's Note.—This valuable progress report of the National Committee on Relative Efficiency of Different Types of Car-Stop Safety Zones and Their Relation to Parking was presented at the recent annual Convention of the National Highway Traffic Association. George A. Walters, Second Deputy Police Commissioner of Detroit is chairman.)

Detroit Experience With Elevated Platforms

The success of elevated platforms for safety zones has been demonstrated in Detroit where one located on Woodward Avenue at the intersection of Gratiot has accommodated approximately 10,000 car riders daily during the hour and half up

to six o'clock p. m., for over a year without an accident. Many people use this safety zone rather than go to more convenient zones which are not elevated. This platform is 216 ft. long, 5½ ft. wide and 7½ ins. high, made of planks, and will be replaced with concrete. For the purpose of building elevated concrete safety zones the city has appropriated $15,000.

In addition to the elevated safety zone at Woodward and Gratiot, Detroit has two others, being at Woodward and the Seven Mile Road, and Gratiot at Riopelle Street. The zone at Woodward and the Seven Mile Road is 84 ft. 10 ins. long, 3 ft. 6 ins. wide and 6 ins. high. We received many complaints from car riders in this section who said their lives were jeopardized by motorists. The traffic there is growing tremendously and moves faster than in the down-town districts. This zone permits large interurban cars with trailers to handle passengers. It has given extreme satisfaction and the Woodward Avenue Improvement Association compliments the department.

The zone at Gratiot Avenue and Riopelle Street is 72 ft. 9 ins. long, 6 ft. wide and 7½ ins. high. At this location the streets run into Gratiot Avenue at such an angle that before this raised zone was established a dangerous condition existed. The traffic is very heavy at this point, it being a main trunk line near the Eastern Market where many thousands of vehicles and many people go every day. The installation of the zone has greatly relieved a dangerous traffic problem and has slowed down traffic and compelled drivers to make the proper turns in going in various directions from this location, and has been a great safeguard for people boarding and leaving street cars at this point.

Results of Inquiry in 15 *Cities*

In response to an inquiry which the committee sent to the chiefs of police of 15 American cities, the advisability of using elevated safety zones to protect pedestrians in the streets from motor vehicles was discussed. Ten cities favor elevated safety zones; five are opposed to their use. Those favoring it are Duluth, Los Angeles, Baltimore, Hartford, Pittsburgh, Cincinnati, Bridgeport, Minneapolis, Dayton and Washington. Those opposed are Buffalo, Rochester, Boston, Chicago and Cleveland.

The height favored ranges from 3 ins. to 12 ins., the latter being the recommendation of Pittsburgh; Washington favors 9½ ins. Widths from 3 to 6 ft. are recommended, Pittsburgh favoring 3 ft. and Washington 6 ft. Regarding the length, most of the cities think that two or three car lengths is about right.

On the question of whether or not the safety zones should be lighted by other means than the use of street lights, all of the cities answer an emphatic yes with the exception of Duluth and Buffalo, which maintain that street lights should be sufficiently adequate to make special lighting facilities unnecessary. Los Angeles says, "Special lights by all means," and Chief Quigley of Rochester says, "Street lights are not sufficient under any circumstances," but Chief Farrall of Hartford says, "In some places street lights might be sufficient." Pittsburgh says their elevated zones require lights at each end, and Minneapolis states that "Street lights never are sufficient."

Regarding the use of safety zones for pedestrians at other points than where car riders use them, Duluth, Los Angeles, Rochester, Cincinnati and Minneapolis answer: "No." Eight of the cities favor them on wide streets where traffic is heavy. Pittsburgh has them at boulevard "Ys" and Washington, at intersecting streets owing to the width of the crossing.

As to whether they should be used at crosswalks at or near the center of all wide streets where traffic is heavy, Duluth, Los Angeles and Rochester do not favor this, Chief Quigley of Rochester, remarking that he "prefers to have traffic move at right angles; no right or left hand turns." Boston suggests that they be placed near or in line with the crosswalks and Bridgeport recommends them at the center of all wide streets. Baltimore, Hartford, Pittsburgh, Cleveland, Dayton and Washington also favor them.

In reply to the inquiry regarding the advisability of using "Islands of Safety" extensively elsewhere than at street car stops, Duluth, Los Angeles, Rochester, Boston, Chicago, Cincinnati and Minneapolis reply in the negative, Mineapolis remarking that roadways should be unobstructed. Baltimore, Pittsburgh, Bridgeport, Cleveland and Washington favor them on very wide streets, and Hartford states that they can be used to advantage at any point where traffic is heavy. Dayton recommends them at street crossings close to schools.

Duluth at present is using safety zone standards with ropes; Chief of Police Major Pugh, however, favors the use of

inlaid safety zones with edges beveled to pavement level.

Los Angeles' streets are too narrow to allow safety zones only at certain intersections. They use a standard with words "Keep to the Right" and use white paint to outline the zone.

Baltimore recommends that the safety zone platforms be either of concrete or wood with 1½ in. pipe standards connected from one to the other with a chain.

Chief Quigley of Rochester remarks that they "are using at street intersections a standard which seems to answer the purpose. It is placed in the center of the square of intersecting streets. In the day time a red flag is placed upon it, and during the night time a red light, which serves a warning to approaching vehicles to slow down and get vehicle under control. Our records show that at such points accidents have been reduced to a minimum. Placing these standards as above compel drivers of vehicles to keep close to the curb when entering the square of intersecting streets and to slow down when turning to the left. They also serve as a marker for the street center and pedestrians when crossing the street, standing on a line with them when vehicles are approaching, are protected from such vehicles as might, if they were not so placed, drive along the center of the street."

Boston has no safety zones. Commissioner Curtis favors iron posts as being the best type of safety zone marker, if any is used.

Our inquiry was referred by the Chief of Police of Chicago to Capt. Lavin of their Traffic Division, who is not in favor of elevated safety zones or islands of safety. Capt. Lavin remarks that "none used in this city because it is believed that an obstruction of this kind placed in the middle of any crowded thoroughfare not only adds to congestion by narrowing the useable width of the street, but is very dangerous to the driving public, at least this is the experience of some of the park systems which are under state control. I assume the theory of islands and raised safety zones is that it affords safety to those who are able to cross through the real danger zone, namely from the curb to the center of the street, but it is hard to see how they afford any protection to those passing over the most dangerous part of the street."

Since receiving the foregoing from Capt. Lavin the Chicago Common Council has passed an ordinance requiring that safety zones be established and a representative of the City Finance Committee visited Detroit recently to investigate the different types of safety zones, including those that are elevated, with a view of their use in Chicago.

Washington advises that they have found it necessary to establish zones adjacent to circles at intersecting streets for the safety of pedestrians.

Detroit Recommendations

Inspector Jackson, commanding the Detroit Police Traffic Division, recommends the following:

1. The use of elevated safety zones wherever traffic conditions will permit.
2. The dimensions as to height, width and length should be made to suit location, taking into consideration the traffic, number of people boarding street cars, and kind and style of cars that stop in the zone.
3. Safety zones should be lighted, either electrically or by acetylene or some other lighting device that would be dependable, but never with an inadequate light.
4. Street lights are not sufficiently adequate to light safety zones.
5. Elevated safety zones should not be erected at other points than where car riders use them. Zones for pedestrians at such places can be designated by markings on the surface of the street or some other substantial way, such as tile, different type of brick, and so forth. There are several locations in Detroit where exceptions to this rule have been found advisable.
6. Elevated safety zones should not be used at crosswalks at or near the center of wide streets where traffic is heavy.
7. "Islands of Safety" elsewhere than at a street car stop should not be erected, except where there is special need for them.

Inspector Jackson states that in his opinion it is advisable to have the raised zone protected by red lights; that there be abutments on each end and that there be no railings or other attachments except lighting connections near the surface of the zone.

Regarding Parking

The immediate vicinity of all safety zones should be kept clean of obstructions, including standing automobiles, so that moving vehicles will have no excuse for encroaching on the safety zones and endangering pedestrians. In order to accomplish this the legislative body must give the police definite authority to regulate the parking and ranking as related to safety zones. The following in effect is

the provision contained in the traffic ordinances of most of the larger cities.

"No rule shall be deemed to prohibit a vehicle from parking at the curb of any street, while taking on or discharging passengers, freight or merchandise; but a vehicle may not stop for this purpose between a safety zone and the curb nearest thereto. No vehicle shall be parked between a safety zone and the curb nearest thereto at any time."

Parking should be prohibited at the curb alongside all safety zones a distance of about 10 ft. in addition to the length of the zone itself so as to afford more driving space between the parked vehicle and the entrance to the zone. If a safety zone is 150 ft. long, parking should be prohibited for a distance of 160 ft.

Loading and unloading of passengers or merchandise alongside of safety zones should be prohibited. This does not impose any hardship as the zones are almost always at the intersection of streets where there is other available space for this work without encroaching on the space alongside the safety zone.

Recommended Legislation

There should be a uniform law enacted in every state establishing and regulating safety zones for car riders at street car stops. The following is offered as a suggestion for this purpose:

"To provide for a state law that will prohibit driving through a safety zone when it is occupied and that will designate a space for 6 ft. alongside the car track at all points where street cars stop for car riders, as comprising a safety zone, even though there are no marks or signs indicating that it is a safety zone." The Detroit traffic ordinance contains such a provision so that there is a safety zone for every car stop.

It should not be necessary that safety zones at car stops be elaborately marked with signs to notify the driver of the existence of such zones for the reason that any marking that is sufficient for car riders should be regarded as sufficient for motorists.

Effective Way of Enforcing Parking Regulations

The most effective way of enforcing parking regulations without using an excessive number of officers is by means of a law such as the Detroit traffic ordinance, the salient points of which are as follows:

An automobile pound to which can be towed vehicles parked on crosswalks, opposite safety zones and elsewhere where they are a serious obstruction; others which violate the regulations can be tagged. This tag notifies the motorist immediately to pay a fine: one dollar for the first offense, three for the second, five for the third and any subsequent violation, with the alternative of being summoned to court.

The parking of a single row of automobiles at each curb where parking is permitted for an indefinite period of time is not in any sense a police problem. It is immaterial to the Police Department whether a parking space be used by one automobile or by a dozen of them during the day. In business sections it does, however, interest the persons who are maintaining the business places and who want their customers to have access to the curb. It becomes a police problem only when over-time parking results in vehicles standing in the street outside of the permitted parking place, comprising double parking, so called. Such a congested condition is the cause of extensive delays and many accidents, to avoid which the enforcement of the parking time limit is necessary.

SOME ENGINEERING FEATURES OF BRICK PAVED ROADS

By James C. Travilla, Consulting Engineer, The Dunn Wire-Cut Lug Brick Co., 211 N. 7th St., St. Louis, Mo.

Brick paving, like the other types of surfacing, should be studied in the light of the economic, engineering and local problems involved for each particular road project. A careful analysis of the factors considered may justify the adoption of two or more types of wearing surface materials or pavement designs for a proposed improvement.

Preliminary Study

The preliminary road study should include the following items: Traffic census, to which should be added a liberal allowance for the increase in traffic and tonnage by reason of the proposed improvement; availability of natural and manufactured materials for wearing surface and artificial foundation, grades, drainage, subgrade soil, climatic conditions, taxable values of the property benefited by the proposed improvement, life of the bonds, first cost, annual cost based on the estimated life of the pavement, maintenance charge, etc.

Engineers are departing from a so-called standard design for brick pavements by reason of the number of types of artificial foundation and kinds of filler for the joint spaces between the brick that are adaptable for use.

Monolithic and Semi-Monolithic Designs

The following brick pavement designs are recognized as good engineering practice: The so-called monolithic design provides for a rigid pavement throughout. The brick are laid in the green concrete or upon an added cement-sand film for a bedding course; the joints between the brick are filled with a rich mixture of sand and cement applied at the consistency of thin cream. Before the cement grout is applied, the brick are thoroughly wet by sprinkling to temper the bedding course and to strengthen the bond of the cement filler to the brick. The design has the special merit of the pavement setting up as a unit, and in saving the expense of concrete curb or edging, as it is not required nor used.

The State and many County Engineers in Ohio, Indiana and Illinois have supervised a large mileage of highway construction, in accordance with the design described. The general practice is to use a 4-in. brick laid upon a 4-in. concrete foundation.

The semi-monolithic design is a modification of the monolithic. The concrete foundation is allowed to set before adding the dry mixture of cement and sand for the bedding course. The design is preferred to the monolithic type for pavements of more than 20 feet in width. On wide roadways it is difficult to draw the cutting template over the green concrete without developing an unevenness in the finished wearing surface.

The cost of monolithic or semi-monolithic brick pavements depends on the proximity of the supply of materials and to the labor scale. Under existing conditions, they will vary in price from $3.50 to $4.50 per square yard.

For the above described pavement designs it may be desirable to allow for temperature stresses. The placing of transverse expansion joints at the end of a day's run and at points of tangent on vertical curves generally is sufficient. Most troubles due to temperature stresses come from structural defects; a slanting joint at the end of a work period may cause the pavement to "blow up." Defective spots will occur when the cement grout filler bridges the joints between the brick. The consistency of the cement grout filler is a most important detail. It should fill the joints the full depth of the brick, otherwise the temperature stresses are not disturbed uniformly to the individual units, which may cause them to shear off at the top.

Preventing Cracks

The monolithic and semi-monolithic designs may result in the pavement developing longitudinal cracks, when the subgrade soil is a heavy clay. The cracks are the result of expansion in the foundation soil due to the infiltration of water and frost action. There elimination should be a matter of proper drainage and soil treatment. The effect of these factors on the slab type of pavements has directed special attention to the importance of soil treatment. A 4-in. bed of cinders placed over the subgrade, in a heavy clay soil, will aid in the elimination of longitudinal cracks. If cinders are not available, top soil or sand mixed with the clay will change its texture, increase its bearing power, and lower its capillarity.

Advantages of Bituminous Filler

A bituminous material for filling the joint spaces between the brick will permit the individual units to adjust themselves to the natural forces and stresses that tend to cause the "blowing up" and cracking in rigid pavements. The filler may be asphalt, pitch mastic or tar.

Foundation

The artificial foundation for a brick wearing surface and bituminous filler may be Portland cement concrete, bituminous macadam, rolled stone or a mixture of sand-clay. The bedding course for the brick may be a cement-sand, or sand and bitumen mixture, or stone screenings, or sand. The admixture of cement or bitumen prevents the sand particles from shifting or rolling, thereby aiding to maintain the true contour of the pavement.

The rolled bases must be thoroughly seasoned and compacted, if good results are to be obtained with the surfacing material. Old macadam roadways may be made adaptable for a brick surface. The thickness of a rolled base should be dependent on the bearing power of the subgrade soil, drainage and climatic conditions. Six or 8 ins. of compacted material, usually, will be found sufficient. The curb or edging may be cement concrete or bituminous macadam.

Edging

A 12-in. bituminous macadam edging on each side of the brick pavement laid upon a rolled base furnishes a means of waterproofing the berm adjacent to the pavement, and to widen the roadway. Vehicle traffic in getting on and off of the berm in wet weather, due to insufficient width of pavement to permit two lines of traffic, will form ruts or grooves, that permit

the infiltration of water into the subgrade and artificial base. This type of edging also affords vehicles an easy approach from the berm to the pavement, as compared to a rigid curb or edging. The cost of maintaining this type of edging is an item to be considered, but its merit for the pavement design under consideration would appear to justify a small maintenance charge.

A brick pavement properly designed to meet the local requirements will not insure a satisfactory wearing surface unless the construction details are given proper attention.

The personal equation entering into road building is a factor that adds to the success or failure of materials built into a pavement of any type. Brick being a "ready made" material, the individual units may be inspected before being bonded into the pavement, thereby securing uniformity in the surfacing material. The word "uniformity" makes a good slogan to adopt for materials and methods of construction, as it directly applies to the life of the surfacing material and stability of the pavement as a unit.

The features of brick paved roads, as set forth, are general in character, but they direct the engineers' attention to the fact that brick pavement designs are local problems, and that designs should not be based on established customs adopted in the early stages of the use of brick as a wearing surface material.

The foregoing matter is from a paper by Mr. Travilla before the Kentucky State and County Road Engineers.

FIRE ALARM SYSTEMS IN SMALLER MUNICIPALITIES

Municipalities and private corporations have for many years recognized the necessity for providing a means for notifying the fire fighting forces when fire is known to exist and the results obtained through the use of reliable fire alarm telegraph systems have been such as to establish the alarm system as a most important factor in the general scheme of fire protection.

The prime function of a fire alarm system is to save time when time is most precious and the value of a modern fire alarm system must therefore be judged by the value of all investments in modern equipment.

A manufacturing establishment makes an investment in automatic machinery because it will save time, thereby reducing the labor cost, and the value of the machinery to the manufacturer is determined not by what he pays for it, but by the value of the time saved in the production of his product. The amount of the investment is necessarily governed by the earning power of the equipment, and it is considered good business practice to install all the time-saving machinery that will return a fair profit to the manufacturer.

A municipality makes a large investment in motor driven fighting apparatus primarily because of the time such apparatus will save in getting into action after the fire department receives the alarm, and, having equipped its department with motor driven apparatus, the municipality has done everything that our present knowledge can suggest along this line. It should be obvious, however, that the motor driven apparatus cannot be placed in motion until the fire department is notified of the existence and the exact location of fire. Unless such notice is conveyed without loss of time, the efficiency of the fire department and the value of the investment in fire fighting apparatus is depreciated in direct proportion to the inadequacy of the means employed for notifying and calling the fire department.

Time the Prime Factor

In recognition of the fact that time is the prime factor in reducing the fire loss, a majority of our municipalities have equipped their fire departments with motor driven apparatus, but in spite of the fact that they have thus employed the fastest known means of getting into action after alarms are received, the fire loss of the country continues steadily to increase and is now averaging well in excess of $300,000,000 a year for the entire country, or more than $3 per capita. These figures represent the actual fire loss only, and do not include the enormous sums annually spent for fire prevention and cost of insurance organizations, all of which must be added to the actual fire loss in order to arrive at the total cost of fire.

The cost is borne not only by those unfortunate enough to have fires, but in the form of insurance premiums is distributed and borne by all of us who directly or indirectly pay fire insurance premiums.

Statistics show that 98 per cent of all fires might be extinguished at their inception by a single bucket of water, consequently the excessive fire loss must be due, in a large measure, to the time con-

sumed in bringing to bear the fire fighting resources of the municipalities, and it is apparent that having done everything possible toward saving time in getting to fires, the only way left still further to reduce the time element is to provide means for notifying the fire department more quickly after fire is known to exist.

Getting to the Fire

From information furnished by many fire departments as to the time fires have been in progress when the departments arrived on the scene, such time may be roughly averaged at from 12 to 15 minutes and delays in communicating the alarms to the fire departments are admitted to be largely responsible for this high average. The fact should also be taken into consideration that many of the most destructive fires have been burning for a much longer period.

Experience has shown that a properly planned telegraph fire alarm system provides the swiftest and most reliable means of notifying the fire department of the existence and location of fire and for reducing the elapsed time between its discovery and the bringing to bear of the fire fighting resources of a municipality.

Adequate Fire Alarm Protection

The question of what constitutes adequate fire alarm protection for any municipality, and the details of such a system, are matters which should properly be dealt with in another article; in a majority of cases the practical application of the principles of fire alarm telegraphy requires a careful survey of the fire district to be protected, but it is proper to state here that such a system should provide means for transmitting without appreciable loss of time, alarms of fire from every point within a fire district where fire is likely to originate, such means to include operating devices accessible to the general public of such a nature that their purpose cannot be mistaken; means of receiving and recording all alarms at the fire stations, and for properly notifying the fire fighting forces, whether paid men or volunteers, of the exact locations from which the alarms are received. In further recognition of the time element, the speed at which alarms are transmitted by the system after the initial manual operation of pulling the lever of a fire alarm box, should be as great as is consistent with the reliable operation of the alarm apparatus.

The argument has been frequently advanced that the greatest value of the telegraph alarm system is derived from the protection it affords to the manufacturing and other business districts of a municipality, and by reason of the lower property values generally and the fact that most residences are now equipped with commercial telephones by means of which alarms may be transmitted, it is unnecessary to have or at least the same degree of telegraph alarm protection is unnecessary in the residential districts as in commercial districts.

That such an argument is not in accordance with the facts is evidenced by the records of the state of Tennessee Fire Prevention Department for the year 1919, which show that of the fires occurring in residences within the municipal limits of cities and towns in that state 57 per cent resulted in total loss. The State of Tennessee is not taken as an example because of the high percentage of total loss resulting from fires in the residential districts, but on account of the fact that the exact statistics of other states are not available.

Using the average per capita fire loss as a basis, a city of 10,000 population would contribute annually to the actual fire loss over $30,000, plus the other items of fire prevention and insurance cost, and also plus the losses due to interrupted business and depreciation of taxable values.

We have on one hand, 98 per cent of all fires which can be quenched in their incipiency by a single bucket of water; on the other hand, the same fires by reason of the delay in bringing the fire extinguishing forces into action, resulting in an actual annual fire loss in excess of $300,000,000.

It is a fact that fires increase progressively in intensity and the values destroyed by fire range from insignificant sums during the first few minutes to heavy or total losses if not promptly checked. A reduction in the average time required to place the fire departments in position to act effectively would be followed as a natural consequence by a correspondingly greater reduction in the fire loss, and in the total cost resulting from fire.

When all the facts are taken into consideration, it would seem that the question of the value of a modern fire alarm telegraph system and the amount of the investment a municipality can afford to make for adequate fire alarm protection resolves itself into a simple mathematical problem.

The foregoing paper by Mr. Stover was presented at the 1921 meeting of the League of Michigan Municipalities.

EQUITABLE DISTRIBUTION OF COST OF CONSTRUCTING AND MAINTAINING STATE HIGHWAYS

(Editor's Note.—The final report of the National Committee on Equitable Distribution of the Cost of Construction and Maintenance of State Highways, of the National Highway Traffic Association, of which Herschel C. Smith, Consulting Engineer, Oklahoma City, Okla., is chairman, is here given in full as presented at the recent annual convention of the association.)

Introduction

In making this final report, the committee realizes that the subject matter is such as cannot properly be touched upon lightly. The committee believes the proper analysis and just distribution of the cost of construction and maintenance of state highways is one of the most important economical principles in the science of highway improvement. Capital in large amount must be secured with which to construct and maintain public thoroughfares, and these thoroughfares must justify this use of the billions of capital by supplying an economic need to the investor in proportion to the amount invested. This final report is submitted with the hope that the association will see fit to continue a committee investigation of this subject to the end that a just, unselfish, and sound influence may be exerted for the economical investment of capital in, and the proper maintenance of, public highways.

Principles Involved

The application of principles of sound investment of capital in various enterprises will necessarily vary according to the state of development of the industry in which the investment is made, but the underlying principles of some investments are narrowly defined and well recognized.

1. The justification of the investment of capital in an enterprise is in that the net economic return which comes to the investor in the form of all benefits derived from the use of the enterprise, is sufficient to reinburse the investor for the original capital plus a reasonable amount for the use of the capital invested, during the service life of the enterprise.

2. The underlying principle of cooperative investments is that a just division of returns is that which makes the return directly proportional to the capital invested. Or applying this same ratio inversely, a just distribution of costs must be directly proportional to the benefits derived.

Because of the total lack of uniformity among the various states in distributing highway cost, the policies varying from a state which has placed the total cost of the original investment in highways on automotive vehicles, to other states which almost ignore this source of revenue, the committee feels it necessary to accept the above commonly recognized principles of investment as the fundamentals on which to build an analysis.

Analysis of Benefits

Many of the benefits derived from the improvements of highways are so obvious that it is necessary only to enumerate them. The following is a list which might be further subdivided but need not be for the purpose of this report:

1. Development of commerce.
2. Development of industries.
3. Development of agriculture.
4. Development of natural resources.
5. Development of rural schools and churches.
6. Development of general intellectual and social life.
7. Improved appearance of roads.
8. Permanency of alignment and grade of highways.
9. Decrease in cost of transportation.
10. Development of methods of transportation.
11. Facility of travel.
12. Increase of land values.
13. Development of economic specialization.
14. Development of back-to-the farm movement.
15. Development of national power.

The above are benefits, all of which encourage the improvement of highways before there were automotive vehicles, and many of which have been recognized and considered adequate justification for the improvement of highways from two thousand years ago up to the present time. A realization of the inherent value of many of these benefits resulted in the development of state aid policies in New Jersey in 1891, and in Massachusetts in 1893, and several other states long before the motor vehicle had become a factor in highway traffic.

The development of tourist travel is a benefit which the committee treats separately because of the division of opinion in its regard. It is certainly a benefit resulting from highway improvement, which gives a net economic return, and the beneficiaries of the return should account for their portion of the capital re-

quired to make the benefit possible. The principal beneficiary, however, is the community being toured, where the tourist spends his money and no proof of this is more conclusive than the open recognition of this fact by all communities, expressed in their every attempt to encourage tourists to enter their territory.

The analysis of the development of motor truck traffic shows that it is a benefit resulting from the improvement of highways which accrues to the general public. The operator of a motor truck derives a benefit from the improvement of highways only in so far as it enables him to transport more advantageously than by other means. The benefit of the improvement coming through motor truck use eventually accrues to the producer and the consumer of the products hauled.

Distinction Between Construction and Maintenance Costs

The benefits from the construction of a highway accrue to the public served by the highway. It is never limited to those who use the highway. The storekeeper, farmer, or man retired from business receives these benefits even though they may never have a vehicle on the road. Nor does the benefit necessarily accrue to those using the road in proportion as they use it. The truth of this statement is evident by comparing the benefits derived by an owner of large tracts of land along the road who may use the road relatively little with the benefit derived by a truck gardener who owns little land, but who may use the road every day. While the benefits derived by individuals do not depend upon the extent of their use of the road, the benefits are only possible by virtue of the road being used. The cost of construction, then, should be distributed according to the benefits derived.

The equity of collecting the cost of maintenance directly from the same source is not so obvious. The cost of maintenance depends directly upon the amount and character of traffic to which the road is subject. Capital, properly invested in highways, should be maintained out of the return from the highways. The amount of maintenance, depending directly upon the use to which the road is put, should be assessed as nearly as possibly directly upon the use of the road.

Assuming that proper regulatory measures are enforced pertaining to the transportation of particularly heavy and destructive machinery over the highways, the maintenance of highways will depend, not entirely, but largely, upon the automotive vehicle traffic. The error in assuming that all maintenance on State Trunk Highways is due to the motor traffic is not great, due to the great predominance of that type of traffic, and that error is fast becoming more nearly negligible as motor traffic supplants horse drawn vehicles.

Conclusion

In this, its final report, the committee submits, for consideration by the members of the association, the following principles relative to the equitable distribution of the cost of construction and maintenance of state highways:

1. That the construction of state highways should be financed by general taxation.

2. That maintenance of state highways should be financed through the medium of license fees for the use of motor vehicles, provided the highways built are of types most economically suited to the traffic to be carried.

3. That the cost of maintenance of state highways should be so distributed as to encourage the fullest development of commercial use of the highways, as therein lies their greatest economic value.

IMPROVING GRAVEL STREETS IN GRAND RAPIDS, MICHIGAN

The Grand Rapids Engineering Society recently appointed a committee to investigate and report on methods of improving gravel streets with a permanent surface top, the committee consisting of H. H. Turner, Purritt A. Parks, Byron E. Parks, Theodore O. Williams, John F. Nellist, C. A. Paige, A. H. Apted and C. J. Wagner. After an exhaustive investigation the committee submitted a report in which it recommends the use of sheet asphalt or a bituminous penetration top. The report says:

The Gravel Streets

In 1898 the practice was started in Grand Rapids of building and improving gravel streets having a combination concrete curb and gutter or a vertical stone curb. The roadway on this type of street was built in four separate layers, totaling 10 ins. in depth. The lower layer consists of cobble stones or large gravel where this could be obtained, and the voids between these stones was filled in with smaller gravel and clay. On each succeeding layer smaller gravel was used and after this the gravel was spread, the clay binder was put on and then the entire course was properly rolled.

There also was a type of macadam street built which was of the same construction as the above described gravel street with the exception that crushed hard heads or limestone was used as the base and limestone dust used for a binder instead of clay as above described.

Auto Traffic Rendered Gravel Streets Obsolete

This type of street was an improvement in street construction over the old type of bank gravel street which was built simply by spreading a layer of gravel over an unimproved street and when it became full of holes another layer was spread. From 1898 until 1918 75 miles of this type of improved gravel streets were built, but as early as 1912 it was discovered that with the advent of the automobile, the surface of these improved gravel streets would not hold up under the traffic which the automobile produced.

The automobile traffic increased so rapidly during the last few years that in 1918 the practice of building gravel streets in Grand Rapids was discontinued and unimproved streets are now improved with either reinforced concrete, sheet asphalt on a concrete base, or brick on a concrete base.

On account of the uniform way in which these improved gravel and macadam streets were constructed, the only objection to this type of street is that the automobiles destroy the surface of the street, which, of course, is not as hard as concrete or sheet asphalt causing the streets to become badly pitted, very rough for traffic, and very dusty in the summer unless properly treated with dust preventing material.

The crushing strength of this type of street, or in other words its ability to carry satisfactorily a surface top which is not easily destroyed as is the gravel top itself, has been proven to be satisfactory under the modern auto and truck traffic and the object of this report pertaining to those improved gravel streets is the following:

1. Recommendations as to the types of top surface with which these improved gravel streets may be covered.

2. An appeal to the citizens of Grand Rapids who live on these improved gravel streets to have these streets covered with a permanent top as soon as possible in order to improve generally the streets in the city of Grand Rapids.

Sheet Asphalt Top

The most satisfactory type of surface top which can be put on these gravel streets is that of sheet asphalt. In applying this the surface of the gravel street is first scarified and then rerolled in order to restore as near as possible the original contour of the street and to make its surface smooth in order to receive the top surface. After this surface has thoroughly dried the asphalt binder course of 1½ ins. is applied and following this the 1½ ins. of sheet asphalt topping is placed on the binder and the surface is then properly rolled to a smooth and even finish.

The cost of this type of topping is between $3 and $3.50 per running foot of property and arrangements may be made with the city to place this on a five year plan so that for a 40 ft. lot the approximate cost would be from $24 to $28 per year for five years.

With this type of topping it is safe to say that no maintenance work will be required on the street for at least 15 years after the top has been put on. There are sheet asphalt streets in the city which have been down for 24 years, and undoubtedly the next 24 years will be harder on city streets than the last, but conservatively speaking, 15 years is short enough estimate for the life of this asphalt topping.

Bituminous Penetration Top

A second kind of topping which may be used on this type of improved gravel or macadam street is a bituminous penetration top and may be either a tar or an asphalt type of topping.

In this type of top the base is prepared in the same way as above described for the sheet asphalt top, but after the base has been prepared and properly rolled it is covered with 2½ ins. of crushed hard heads or limestone. Following this hot asphalt or tar, as the case may be, is poured on this stone which fills the voids and acts as a binder to hold the stones together. Following this a layer of smaller stone is applied on the bituminous material and it is then properly rolled and the entire top is bound together with the tar or asphalt.

After this first rolling has been completed the entire surface is then covered with a coat of hot tar or asphalt and a layer of pea gravel is spread on this surface coat which after being properly rolled finishes the surface and produces a very presentable type of top.

The approximate cost of this is $1.75 to $2.25 per running foot of property which on a five year plan would cost the property owner for a 40 ft. lot approximately $14 to $18 per year for five years.

There is, however, a decided difference in the wearing qualities of this type of topping as compared with the sheet asphalt in that approximately every three years a new seal coat of pea gravel must be put on this type of top. The approximate cost of this seal coat is 25c per running foot of property so that in the course of 15 years in which nothing must be done with a sheet asphalt top, at least five seal coats must be applied.

Considering both types of pavements it may be said that the ultimate cost at the end of 15 years is approximately the same in each case, but during the 15 years the sheet asphalt pavement always presents a much better appearance and it is more satisfactory in every respect than the penetration type of street.

It is safe to say, therefore, that between the two types of pavement the sheet asphalt in the long run is the most satisfactory and economical, although the initial cost is somewhat greater than that of the penetration top.

All of the members of the committee who have signed this report have made a personal investigation of the gravel street situation in Grand Rapids and are unanimously of the opinion that the report as rendered is the correct method of handling this large mileage of improved gravel streets which is being worn by automobile traffic. They are also of the opinion that this should be done as soon as possible in order to improve the general street condition in Grand Rapids.

THE COST FACTORS OF CONSULTING ENGINEERING PRACTICE

By Charles H. Young, President Central States Engineering Co., Muscatine, Ia.

(Editor's Note: We were greatly interested in the following paper, presented by Mr. Young before the 1921 meeting of the Iowa Engineering Society, as it gives an exceptionally concise summary of the cost of conducting a consulting engineering business. Inasmuch as we have a great many valued readers among the consulting engineers we especially invite discussion of and comment upon this article. The discussions may, of course, take any direction that our readers may elect. It is hoped, also, that municipal and county engineers and other officials will read this article and thereby appreciate the cost of a service which, to be satisfactory, must always be accorded adequate compensation.)

In attempting to analyze the subject of cost factors in engineering practice it was discovered that the cost factors are of a great variety and are dependent upon the class of service that an engineer in practice performs. There is involved, also, the kind of organization, the kind and extent of trade area tributary to the locality within which the engineer functions and the amount of energy spent in educational work of clients and of the engineer, himself, in continuance of business, the manner of development and the period of development.

It seems that there is no general method of procedure adopted by the various engineers, so that a standardization of factors could not be made applicable to each and every case.

Classes of Consulting Engineers

It is therefore necessary to divide the engineers into seven (7) classes:

Class A, an engineer who may or may not have a technical education, who has office at home and operates a one man practice.

Class B, an engineer who has a small office and employs assistants part time and operates balance of time in one man practice.

Class C, an engineer who has business organization, stenographer, chief engineer, and departments, employing a number of men in order that he may perform various classes of service.

Class D, an engineer who holds some position which provides office equipment and salary and devotes part time to private practice.

Class E, a professor who devotes excess time to private practice in order that he may gain such experience as will make him better qualified to teach the subject which he has in hand.

Class F, an engineer who consults only on special projects and confines himself to development on only large projects along a particular line.

Class G, an engineer who does some contracting and fills in his time practicing engineering.

Cost of Engineering Education

It might seem proper at this time to discuss somewhat the cost of an engineering education because this is the foundation for a lasting superstructure of engineering practice. Considering that the cost of a college education is $500 per year and that some classes of engineers would require a four-year course and some six years, some engineers would acquire a larger part of their education from their personal ability to study out problems in their own way. Really when you consider education in engineering, the practical education is the important part.

Billy Sunday's diagnosis of an educated man is, a man who knows a little and knows where to get what he wants when he wants it and knows how to use what he gets when he gets it. So the factor of education would fluctuate in that it would depend upon a man's ability to apply his knowledge practically before it could be ascertained what the value is of that knowledge to his business. In general, however,

Class A would require 4 years at $2,000, practical experience $1,000.

Class B would require 4 years at $2,000, practical experience $1,500.

Class C would require 4 years at $2,000, practical experience $3,000.

Class D would require 4 years at $2,000, practical experience $5,000.

Class E would require 6 years at $3,000, practical experience $3,000.

Class F would require 6 years at $3,000, practical experience $3,000.

Class G would require 4 years at $2,000, practical experience $2,000.

It has been computed that 25 per cent of their time is all that classes D and E could devote to practice because of other duties. In considering practical experience, a five-year period has been used.

Necessary Equipment

Class A, tools and fixtures, transportation facilities, $2,000.

Class B, tools and fixtures, transportation facilities, $3,000.

Class C, tools and fixtures, transportation facilities $1,500.

Class D, tools and fixtures, transportation facilities $3,000.

Class E, tools and fixtures, transportation facilities $1,000.

Class F, tools and fixtures, transportation facilities $2,000.

Class G, tools and fixtures, transportation facilities $3,000.

Continuance of Business

Ordinarily, the first year of Class A's time furnishes him 50 to 70 per cent employment; second year, 60 to 80 per cent employment; third year, full time. After the third year he usually enters into Class B and continues with 50 per cent assistants the fourth year, 75 per cent assistants the fifth year, and full time assistants the sixth year. If he is successful and energetic and has the personality and natural ability he will enter the seventh year with more than one assistant and be in Class C. In the tenth year of practice he has good chances of operating three or four departments, if he is energetic.

It may be necessary some time during this career for him to enter Class D in order to fill in part time in some position or he may be sidetracked into Class E for a time or permanently. There is also a chance of sidetracking into Class G, but very few engineers reach Class F until after long years of experience. Very often Class E starts in Class A and develops more rapidly, arriving usually in Class F after he has the business ability. It seemed necessary to discuss this question because these facts are the foundation for considering the cost factors in engineering practice, and it almost seems as though any formula which might be

CENTRAL STATES ENG. CO.

DAILY REPORT

Client's Name _____ Date _____

Employee's Name _____ Hrs. Worked _____

Nature of Work _____

Expense	Amt.	Paid	Remarks
Auto			
R. R. Fare			
Transfer			
Brdg. Toll			
Meals			
Lodging			
Stakes			
Stationery			
Misc.			

Remarks _____

FIG. 1. DAILY JOB TICKET FOR KEEPING COST OF CONSULTING ENGINEERING WORK.

created would consist almost wholly of variables and very few constants. In solving for X, which would represent the income of the various classes, only general statements can be made which would be modified by the various conditions entered into. It can be said, however, that there are items which enter into almost every practice, which might be enumerated as follows:

Promotion Expense

This item covers the expense of pro-

moting jobs, dues to associations, etc. It is necessary for the engineer to keep up with the times in order that he can better serve his clients, just the same as any lawyer, dentist, or doctor, who is a professional man, must acquaint himself with the newest ideas. He must, also, watch the change of personnel of different bodies of men and keep them in touch with his qualifications in the work he is doing in order that the best interests of his business might be perpetuated.

Bonds

bonds, which amounts to 1 per cent of the penalty of the bond or 1 per cent of the bond required. As the amount of the bond furnished is fixed by the parties requiring the bond, this is an indefinite expenditure. The amount of the bond is paid by the engineer and is an item of expense.

Insurance

This item represents the cost of working men's compensation, which is compulsory under the State Law. It is 71c per hundred for surveyors, 9 per cent for draftsmen, 2½ per cent for engineers on tile ditches, $3.75 per hundred for engineers on floating dredge work, $3.45 per hundred for engineers on suction dredges and other classes. This item fluctuates from time to time.

Traveling Expense

This item represents the expense of traveling to jobs you do not get and visiting jobs under construction in order to ascertain information. There are many trips necessary in order to get final settlement on the work after it is completed. This, also, includes expenses to society meetings in order to keep up with the times.

War Tax

This item must be an item on all costs, as it represents the tax not only on profits but also on telephone, telegraph, and express bills.

Interest on Investment

This item must be a part of all estimates of cost amounting at present to 7 per cent.

Interest on Jobs

This is not interest on investment but interest only on money borrowed to carry on jobs during the process of the work. That is, engineers must receive their wages and expenses must be paid regardless of whether or not collections are made. Very few assistant engineers have enough money to wait until preliminary expense is paid. Again, a great many warrants must be discounted from 1 to 4 per cent, dependent upon the credit of the project, before the banks will cash them, because the banks have to hold these warrants until the bond issue is put through. Many warrants are marked "Not Paid for Lack of Funds."

Discount

As mentioned above, it is necessary sometimes to discount warrants and hold bills between board meetings. Sometimes one cannot cash these warrants for several years.

Job Expense

This item includes miscellaneous transportation of men, expense of lost time for men receiving steady pay, storage, job office rent, etc.

Repairs

This includes the cost of repairs to tools and equipment and tools lost or stolen.

Depreciation

Every engineer has depreciation on his equipment which amounts to 10 per cent per annum on the cost of equipment. In some cases this should be doubled.

Risk

This factor is indeterminate. Sometimes during preliminary surveys the bills are not paid. The preliminary bond sometimes is insufficient or the work is held up by legal procedure so as to be detrimental to the engineer's pay. The money must oftentimes be borrowed for an indefinite time to carry on business and discounts. Fees for testimony at

CENTRAL STATES ENGINEERING CO.
OF MUSCATINE, IOWA

IN ACCOUNT WITH

Year Month	Date		Chief Engineer	Asst. Engineer	Draughtsman	Field Helper	Transportation	Meals Lodging	Miscellaneous	TOTAL

FIG. 2. COST KEEPING FORM FOR CONSULTING ENGINEERS.

$1.35 to $4 per day can be enforced by law.

Office Expense

This item represents stenographer, rent, light, heat, janitor, postage, telephone, telegraph, control systems, books, supplies, advertising, and expenses of like nature which every business must pay.

Salaries

This question of salaries would be a local one and be easily determined by a summation of the salaries paid during the year, but it is hard to anticipate just what salaries should be paid on any particular job because of the fluctuation of the other factors involved. One can only draw general conclusions after a definite experience in a particular locality and after a careful computation of costs and the various factors involved, before he can determine what is a fair amount to pay in salaries. It is often hard to tell until

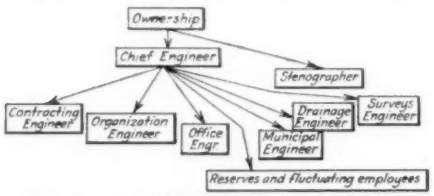


FIG. 3. ORGANIZATION OUTLINE FOR CONSULTING ENGINEERS.

several months into the next year's business what the profit of the business is, until all the collections have been made for the previous year up to January first. Sometimes accounts of one year will not be paid for months after the year's work has been completed. Therefore the determination of profit cannot definitely be ascertained until one knows whether or not he had any bad accounts. Many a business has failed, not because the profit was not in the procedure of the work, but because the accounts of the business could not be collected.

Method of Cost Keeping

The method of cost keeping which we have adopted is to make out a ticket in duplicate for each job performed each day. We file one of these tickets under the client's name and one ticket under the employee's name. From these tickets under the employee's name we make up his salary and from the tickets under the client's name we make up the client's bill, which might consist of the work of several men. These tickets are 3x5 ins. and can be filed away in an ordinary 3x5-in. card index box. They are made up in little books, 50 to a book, and each man makes out his own ticket. Fig. 1 is a copy of the form which we use

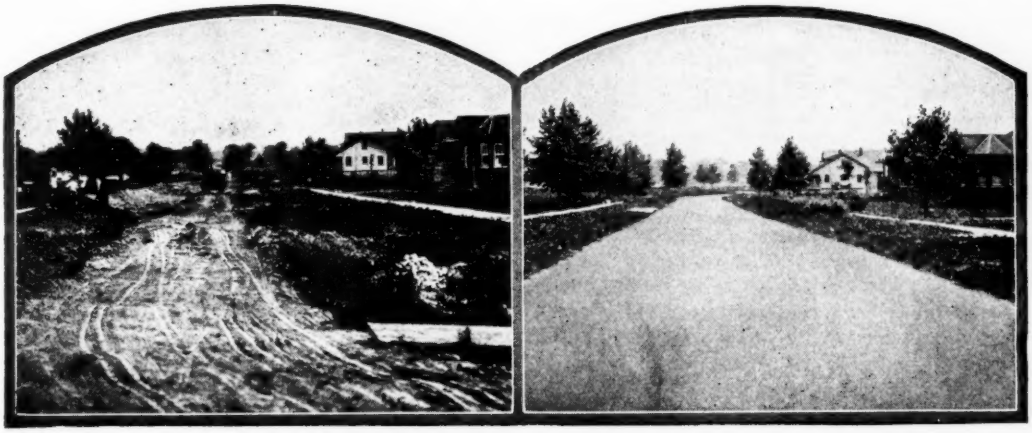
In transferring this item to the client's bill it is itemized in columns of Chief Engineer, Assistant Engineer, etc., as shown in Fig. 2.

No material is secured without an order and this keeps the amount of materials purchased on the stubs of our order book. This way we are able to keep an itemized account of every transaction and every item, whether it be transportation, time on promotion, traveling expense or any of the items above enumerated.

One factor that is indeterminable but must be taken into account is the loyalty of the employee and his adherence to the ethics of the profession. Oftentimes this item is very large when one has to keep training men over and over again to fill the different departments of the work. While it is always a source of gratification to see one's employees advance there often becomes a limit to the amount of salary that can be profitably paid. Often one year is a good year and another year is a bad year, so that the cost of doing business fluctuates with business conditions, and the employee not having the facts at hand may jump at conclusions and often attempt to supplant the employer after he had been nursed and fed to a healthy condition by a well meaning parent. As a usual thing, this class of employee receives the same treatment when, in later years, he fills the shoes of his employer.

Profit Sharing Plan

Whether or not the employer would receive an apportionment of the profit would depend upon his loyalty, his attention to business and the success of his work, and the class of service the engineer performed. And again it would depend upon the value of business over a period of years, taking the good years with the bad years, the successful collections of accounts, and the education of clients. This factor of education of clients would fluctuate greatly with the need for the same. However, any business needs to educate its clients. Very few clients understand the functions of an engineer, because they would almost need to be engineers themselves in order to realize what is necessary to produce certain results. The clients of an engineer are just like any ordinary man who goes to our legislature. They cannot be expected to be versed in every question from the boll-weavil to the flying machine, but they must inform themselves upon various subjects in order to determine their course in voting. Likewise, if an engineer does not give his clients a concep-



*Wretched condition of Kenilworth Avenue, Villa Park, Ill., **before** the use of Tarvia*

*Picture of same section **after** being constructed with "Tarvia-X." Note excellent condition of road today*

Good Roads Boost Property Values—

YOU can easily see how Tarvia has improved property values along Kenilworth Avenue, Villa Park, a pretty suburb of Chicago, Ill.

Here was a stretch of road that was bumpy and "hard going" on even the best of days, while during the Spring thaw and after a heavy rain, it was practically impossible to navigate.

That was its condition before the road authorities of Villa Park turned to Tarvia. Tarvia will make this road last for years. With but occasional inexpensive treatments with "Tarvia-B" as the traffic demands it, it will always be free from mud and dust, waterproof, frost-proof and traffic-proof. It has increased the desirability of the abutting property many hundred per cent.

For these reasons Tarvia streets have the hearty approval of taxpayers everywhere. The story of Kenilworth Avenue is being repeated in many cities and towns all over the country.

Tarvia is a coal-tar preparation for use in constructing new macadam roads or repairing old ones. One Tarvia road in your community will prove to you and your townspeople how Tarvia roads increase property values and decrease taxes.

Illustrated booklet telling about the various Tarvia treatments free on request.

Tarvia
For Road Construction Repair and Maintenance

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

New York, Chicago, Philadelphia, Boston, Detroit, New Orleans, Birmingham, Kansas City, Salt Lake City, Seattle, Peoria, Atlanta, Johnstown, Lebanon, Youngstown, Toledo, Elizabeth, Buffalo, Baltimore, Omaha

The Barrett Company

St. Louis, Cleveland, Cincinnati, Pittsburgh, Minneapolis, Dallas, Nashville, Syracuse, Duluth, Milwaukee, Bangor, Washington, Columbus, Richmond, Latrobe, Bethlehem, Jacksonville, Houston, Denver

THE BARRETT COMPANY, Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S.

tion of engineering service, then he cannot expect much business. It is my opinion that the education of clients is one of the largest factors of cost which enters into the engineering practice.

Organization Outlines

Engineers operating in Class C, especially, must devise some operating plan or method of operation and feed it down to the different departments in some systematic method. There is a cost factor here, then, of devising ways and means economically to transmit the responsibility to the various departments. Quite a bit of money can be saved clients where men in different departments are eperienced and advanced in a particular class of work, thus rendering competent service which could not be otherwise rendered by one engineer who would not be versed in all kinds of engineering business. This factor, then, would aid in the economic carrying out of a project of larger magnitude. We are showing in Fig. 3 an organization outline which might be a factor in successful operation, consequently a factor of cost.

Summary

An attempt has been made in the foregoing discussion to present the factors of cost in order that any engineer in business may apply those factors of a cost keeping system and thus over a period of years localize different cost factors to the class of business he performs and to the community in which he operates. An attempt has also been made to set out as nearly as possible the separation of cost factors encountered in each class of business enumerated. It is needless to say that it is necessary to estimate a number of these factors, but with the factors at hand any engineer will be able to fill in his own table and to recognize that such factors exist if he has not previously realized it. Some of the factors may not be involved in some classes of business, but the engineer in practice can select those factors which are applicable to his particular class and ultimately arrive at his own conclusions. It has been recognized that the reason why computations vary in engineering lines is because engineers do not operate on the same basis and do not perform the same service for a given price. Engineers do not all have the same will power to put projects across under adverse conditions. So the percentage of "I will do it" which a man possesses would be a factor in the cost. This is a larger factor than might be anticipated at first sight. It has been said that if all engineers engaged their services on the same basis that ultimately the engineering profession would receive what it is justly entitled to for services rendered and the clients would better understand what they were receiving for the price they paid. The existence of this condition has caused the writer to attempt to analyze cost factors in order that a basis for standardization could be arrived at with a view to rendering some small service to the engineering profession as a whole and to the general public as well.

PLANTING TREES ALONG PENNSYLVANIA HIGHWAYS

During the last few weeks the Pennsylvania State Highway Department has planted a large number of American elms and sugar maples along State Route No. 123, between Gettysburg and Harrisburg. The planting of several miles of trees was under the direction of attaches of the State Forestry Department.

"It is our aim eventually," said Highway Commissioner Sadler, "to beautify the main highway routes in Pennsylvania through the intelligent planting of shade trees."

A tentative plan has been worked out with the Forestry Department whereby a comprehensive system of planting trees along State Highway Routes will be taken up. The Highway Commissioner will designate the highway to be planted and the particular section involved.

The Commissioner of Forestry will make a survey of the planting site, recommending the species to be planted; and giving in detail the planting operation, such as distance, care of stock, size and depth of holes, setting of the trees, fertilizers, staking of the trees, planting crew, necessary tools, approximate time required and other details.

The State Foresters will direct operation and inspect the trees from time to time, giving instructions concerning the subsequent care and treatment.

In order to make a real success of this work it will be necessary to obtain the complete co-operation of the adjacent land owners, obtaining their permission to remove undesirable trees along the highways right-of-way which are 4 ins. or over in diameter 2 ft. above the ground. The co-operation of companies operating overhead service lines will also be necessary. The trees will be furnished by the Forestry Department as fast as they become available from the State Nursery.

WATER WORKS SECTION

WATER TREATMENT FOR SMALL MUNICIPALITIES

By E. M. Partridge, Chief Chemist, The Refinite Co., Omaha, Nebraska.

As the possibilities and benefits of improving water supplies become better known, water treatment is becoming more common among the smaller towns and cities. The first consideration is to make certain that the water is a safe one to drink and free from disease producing organisms. However, the water need not be hygienically unsafe before treatment is desirable. A "safe" water may be so muddy or colored as to be distasteful. The removal of suspended matter and color and, at times, iron and dissolved gases as well, will improve its appearance and give it a pleasing taste and smell. At times, it is necessary to neutralize acid mine waters or to counteract pollution from neighboring cities or industrial plants. As the industrial value and other advantages of soft water become better known, the inclusion of softening as one of the objects of treatment is more common.

The treatment necessary varies with the conditions, but always involves the employment of certain fundamental practices to accomplish the various results desired. Depending upon the amount and nature of impurities present, the methods or combination of methods chosen varies. The impurities present will be either in suspension or solution. If they be in solution, means must be found to precipitate them in insoluble form when they may be handled in the same manner as the matter already in suspension. Matter in suspension is removed through sedimentation and filtration. Sedimentation or filtration are assisted by the aid of chemicals which, acting as coagulants, draw the finer particles together into larger aggregates and allow them either to settle more rapidly or be more easily filtered. In the processes of sedimentation and filtering, or softening and filtering, if properly handled, it is possible to get an almost complete removal of bacteria from the water. To insure complete sterilization of the water, additional treatment in the form of chlorination, ozonation or the rays of ultra violet light may be given.

Water Treatment Processes

The various processes may be listed as follows. They do not necessarily come in the sequence given, nor are they all necessary for any given water.

1. Aeration—Allows dissolved gases to escape and oxidizes iron present in solution to an insoluble form which may then be handled as suspended matter.

2. Addition of lime and soda—To render soluble impurities insoluble, so that they can be removed by sedimentation and filtration. Removes iron and hardness and serves as coagulant.

3. Addition of coagulants—To collect the fine floating particles into larger masses so that they will settle and filter with greater ease. May be used to correct alkalinity after lime-soda treatment.

4. Sedimentation.

5. Filtration.

6. After treatment by ultra-violet light, chlorination or ozonation.

Treatment of Surface Waters

Many water treating plants are in the main, filtration plants alone. The water is handled first in settling basins where, with the aid of a coagulant, a large part of the suspended matter present is settled out and deposits on the floor of the settling basins. It is then passed to a sand filtration plant either of the gravity or pressure type.

There have been many articles written on the subject of sand filtration. The art is well understood and in application in numerous instances. In the list of possible steps in water treatment given, it will be noticed that the third, fourth and fifth steps mentioned are stressed in this form of treatment namely: Addition of coagulants; sedimentation; and filtration.

The addition of lime and soda may occur and result in some softening action on the water, but when the plant is intended primarily as a filtration plant, these chemicals are added if at all, to insure a sufficient alkalinity in the water properly to decompose the coagulants added. The coagulants used are soluble

salts, which, when brought in contact with alkaline salts, are decomposed with the formation of an insoluble hydrate which acts as the coagulating medium. When alum or sulphate of alumina is used, the native alkalinity of the water serves as the decomposing agent, or if this be insufficient, soda may be added. When sulphate of iron is used as the coagulant, it is necessary to add hydrated lime, since iron sulphate does not react very satisfactorily with natural alkalinity in water. The point to be observed is that but relatively small amounts of chemicals are added, just sufficient to form a coagulum which aids in settling out the suspended matter before the water is filtered. This coagulum serves the further purpose of building up of a gelatinous coating on the sand particles in the upper portion of the filter bed. This coating of gelatinous matter on the sand particles increases materially the efficiency of the sand bed; with it present the filter can remove the finest suspended matter and also absorb coloring matter, odor and tastes.

This type of treatment is especially adapted to the betterment of surface supply waters which are very apt to carry more or less silt, clay and other matter giving it often a high turbidity. It is the ordinary form of treatment for river waters and is now used with satisfactory results at many cities located on the banks of streams. Such waters are generally more or less soft, the waters handled being often but a few grains hard and generally less than ten grains hard.

Disadvantages of Many Well Waters

Many of our smaller cities, however, are not located on streams which will give them water of a desirable type. They find it necessary to depend on water pumped from driven wells. They may be fortunate enough to locate a water supply which is entirely suitable for use but well water is very apt to have certain disadvantages. It is likely to be charged with an excess of carbon dioxide which causes the water to dissolve iron from the iron piping used to carry it, making "red water" and giving rise to stains on the plumbing fixtures. It often contains considerable iron in solution when drawn; the water will be clear at first, but on standing will turn yellow through precipitation of the iron on the escape of the carbon dioxide gas which held it in solution in its natural state.

Again such water is often undesirably hard, the lime and magnesia in the water rendering it very unsatisfactory for use. It consumes large amounts of soap before a lather can be formed with it and gives large amounts of gummy soap curds. The hardness causes scale in boilers and water heaters, sometimes closing hot water pipes entirely. It cannot be used to manufacture good, clear ice and proves itself objectionable in numerous other ways. Well waters of this type are not apt to be contaminated with objectionable bacteria and organic matter in solution, their faults are more apt to be in their corrosiveness, iron content and hardness.

Aeration

If it be desired to remove only the iron and corrosive properties of the water, thorough aeration followed by sedimentation and filtration may be all that is needed. Aeration may be given by spraying the water into a settling basin or by allowing it to trickle down over a series of baffle plates. The effect is to release the carbon dioxide from the water and throw the iron out of solution so that it may be readily filtered off by a sand filter. Enough carbon dioxide escapes during the process to reduce the corrosive properties of the water to a negligible degree.

Water Softening

This treatment does not soften the water. If in addition, it is desired to soften the water, this treatment will not suffice. A treatment approximately that first outlined involving the steps of (1) the addition of coagulants, (2) sedimentation and (3) filtration is necessary. The treatment differs in that instead of adding just the chemicals which cause coagulation, sufficient lime or lime and soda is added materially to reduce the hardness of the water. Softening may be very desirable, but the cost of softening too high to be practical and the water after softening of undesirable quality.

The question of whether or not softening is practical and desirable must be settled on the score of the nature of the water. The method of treatment is to add sufficient lime and soda to the water to react with the hardness and effect the desired softening, to pass the water into a properly designed sedimentation tank where the precipitate formed may settle out, to add sufficient iron sulphate, niter cake or similar substance to neutralize the excess alkalinity of the softened water and prevent after precipitation from it and finally to filter and deliver it for use. The addition of lime and soda to water to soften it is now a well known process, but a brief explanation of the process may not be out of place.

The Lime and Soda Process

Hardness in water is due to the presence of dissolved salts of lime and magnesium. The salts commonly found are the bicarbonates and the sulphates of lime and magnesium. Occasionally, chlorides are present in considerable amount. In addition to these salts causing hardness, we may find the bicarbonates, sulphates or chlorides of sodium. In large amounts they are objectionable, but they do not destroy soap or form scale as do the hardening salts. When calcium and magnesium are present in the bicarbonate form, they are in effect present as insoluble limestone or dolomite made soluble and held in solution by carbon dioxide. For instance, calcium carbonate or limestone, an almost insoluble substance, dissolves readily in water containing an excess of carbon dioxide, the carbon dioxide uniting with it to form soluble calcium bicarbonate. Any process which will remove this carbon dioxide will render the limestone again insoluble.

Temporary Hardness

If we heat the water, it will be driven off and the limestone becoming insoluble, will settle out of the water. This is the cause of the "furring" of kettles and because bicarbonate hardness is thus easily removed by boiling, it is called temporary hardness. The addition of lime to unite with the carbon dioxide will effect the same result. The lime unites with the carbon dioxide to form a fresh amount of limestone and this, together with the limestone already present and now made insoluble through losing its carbon dioxide, comes out of solution. When temporary hardness is thus removed by the addition of lime, not only does the lime added come out of the water as an insoluble precipitate, but something in the water, the calcium bicarbonate, is removed, the total dissolved content of the water being less after treatment than before.

Permanent Hardness

If any sulphate or chloride hardness be present, boiling the water will not affect it. It is, therefore, called permanent hardness. For instance, a water containing dissolved calcium sulphate or gypsum will have just as much of this substance present after boiling, as before, and in unchanged form. The addition of lime does not affect it either.

To soften water containing calcium sulphate we add soda. The calcium sulphate and soda possess together chemical groupings from which insoluble calcium carbonate or limestone can be formed. The calcium sulphate furnishes the calcium and the soda which is sodium carbonate, furnishes the carbonate radical. When they are mixed a white cloud appears which is the calcium carbonate forming and precipitating, but the fact must be remembered that something remains in the water. The remainder of the soda and of the calcium sulphate or gypsum form sodium sulphate (Glauber's Salts) and remain in solution. This happens whenever permanent hardness is softened by the addition of soda. The hardness is removed but a soluble though non-hardening salt appears in its place. This is different from softening temporary hardness with lime when a removal of the hardness is effected without a substitution of a corresponding sodium salt. In case the temporary or permanent hardness present is due to magnesium salts instead of calcium salts, the processes involved are exactly the same except that lime is first added to change the magnesium salt to a calcium salt.

Treatments for Temporary and Permanent Hardness

Thus, in general it may be said that temporary hardness requires lime treatment, and permanent hardness requires soda treatment, while lime in addition is required when the hardness is due to magnesium salts whether present as temporary or permanent hardness. Furthermore, when temporary hardness is treated, it is removed from the water but when permanent hardness is treated, it is rather converted into an equivalent amount of a non-hardening salt, no actual reduction in the total solid content of the water occurring. It is apparent that the cost of chemicals to treat the water will vary, not only in proportion to the hardness of the water, but also according to the kind of treatment that must be given, whether chiefly lime treatment or chiefly soda treatment since soda is more expensive than lime. Furthermore, the desirability of treatment when a large amount of permanent hardness is present so that considerable sodium salts will be left in the water after treatment is a matter of doubt.

Waters of Equal Hardness Vary in Treatment Cost

To illustrate how waters of almost equal hardness may vary as regards cost of treatment, depending on the form in which the hardness is present. we will cite two examples.

A well at Ross, Florida, analyzes as follows:

Substance	Grains per Gal.
Calcium bicarbonate	15.38
Calcium sulphate	3.54
Magnesium sulphate	10.43
Sodium sulphate	2.74
Sodium chloride	2.30
Aluminum oxide	.26
Iron oxide	.03
Silica	1.54
Carbon dioxide	.70

In terms of calcium carbonate, it has a total of 20.79 grains per gallon.

Compare with this, the water from a well at Lafayette, Indiana:

Substance	Grains per Gal.
Calcium bicarbonate	22.10
Magnesium bicarbonate	9.76
Magnesium sulphate	.44
Sodium sulphate	3.04
Sodium chloride	1.30
Aluminum oxide	.20
Iron oxide	.18
Silica	.89
Carbon dioxide	1.00

In terms of calcium carbonate, it has a total hardness of 20.57.

Here then we have two waters, one 20.79 grains hard, the other 20.57 grains hard. It will be noted, however, that a relatively large part of the hardness in the first water is sulphate hardness, while the hardness of the second water is mainly carbonate hardness. The first water will require 2.56 lbs. of lime and 1.91 lbs. of soda for treatment of each 1,000 gals. The second water will require 3.47 lbs. of lime and .06 lbs. of soda for each 1,000 gals. At $16 a ton for hydrated lime and $40 a ton for soda this would make the cost of treating the first water 5.868 cts. per 1,000 gals. and 2.896 cts. per 1,000 gals. on the second water, or in other words, with two waters of the same total hardness, the cost of chemicals to treat them may be twice as much in one instance as the other. With waters of greater hardness, the cost of treatment is proportionally greater. When estimating total cost of treatment by this method a fair amount to consider for treatment is a million gallons a day.

The cost of handling this amount of water aside from the cost of the chemicals but allowing for attendants to operate the plant, depreciation on the equipment, maintenance and power for operation will be close to 2 cts. per 1,000 gals. If we consider handling the more favorable of the two waters mentioned above we may expect then a cost of approximately 5 cts. per 1,000 gals. with an initial investment of $15,000 for the softening equipment when the plant is to be built to handle 1,000,000 gals. per day of 20 grain water in which the hardness is mainly temporary hardness.

Requires for treatment per 1,000 gallons—2.56 lbs. hydrated lime @ 8c	$2.048
1.91 lbs. soda @ 2c	3.82
Cost treatment per 1,000 gals.	$5.868

made before stating a price show necessity of considering local conditions before an exact cost can be determined. The prospect outlined shows that the cost is not so great but that when the advantages of soft water become more fully appre-

Requires for treatment per 1,000 gallons—3.47 lbs. hydrated lime @ 8c	$2.776
.06 lbs. soda @ 2c	.12
Cost treatment per 1,000 gals.	$2.896

The many conditions which must be ciated we may expect to see a great development along this line. The lime-soda treatment will leave the water in an alkaline condition which is objectionable in taste to some people. This feature can, however, be eliminated by the addition of neutralizing chemicals after the softening is completed.

Cost of Treatment

The cost of treating a water in this manner is thus not prohibitive. The exact cost will vary with local conditions but an approximation from figures at hand may be made as follows. A city of 6,000 inhabitants using on an average of 160 gals. of water per capita per day might be rated as using 1,000,000 gals. of water per day. A lime-soda water softener complete with chemical tanks to add the necessary chemicals, of sufficient size to allow ample settling space and with a filter which with proper handling will deliver a clear, softened water free from objectionable taste can be built for not more than $15,000.

ECONOMIES OF THE BOILER ROOM

By John M. Drabell, Mechanical and Electrical Engineer, Iowa Railway and Light Co., Cedar Rapids, Iowa.

It is my intention to sketch, briefly, some of the things that can be done in every boiler plant in order to better its operation and economies. Boilers in general divide themselves into two classes; water tube, in which the water is contained inside the tube and the gases from the furnace pass over the outside of the tube and the horizontal return tubular boiler in which the water surrounds the

tube and the hot furnace gases are exposed to the shell of the boiler and also pass through these tubes, or flues as they are called. In discussing economies that can be effected, the writer will point out at different times the relative effects of different conditions on each type of boiler.

In the design of a great many power plants, both very small and very large, the boiler room has not received the attention that it should have received, with the result that it has not been a particularly desirable place to work and a great many operators of power plants have been too prone to consider that any old kind of labor was good enough for the boiler room, that all it required was a strong back and a weak mind, and that if the man could merely shovel in a large quantity of coal during the working hours, he was a good fireman.

Ventilation, light, fresh-air, lockers, and washing facilities for the men cost but little and go a long way toward raising the morale of the boiler room force. A clean, light, airy boiler room will attract good men, whereas a dirty, dark hole in the ground will attract no one who can get a job anywhere else, so if you want to build up the efficiency of the boiler plant, first provide some decent working conditions for the men and an attractive wage. A fireman can waste in one day in a power plant his entire month's wage, so pay somewhat more than common labor's wages and you will start to bring about the desired results.

Causes of Losses

What are the losses that occur in a boiler plant? They may be enumerated as follows:

Dirt

Both inside and out on boiler tubes: Accumulation of scale on boiler shells and drums. This is indicated by a high flue gas temperature and also can be readily observed by even the slightest inspection.

Air Leaks in Boiler Settings

Too much attention cannot be paid to cracks in boiler settings and as soon as one is noted, it should be immediately plastered up. There are many good makes of plastic compound carried on the market for sealing up boiler settings and maintaining them permanently tight.

Ash Pits

On stoker fired boilers, the ash pits and doors must be as tight as the settings for if not, air will leak in and cause a loss in efficiency. On hand-fired boilers, the ash pit doors should be removed as there is a tendency for the firemen to attempt to regulate the amount of steam the boiler is developing by opening and closing these doors, whereas they should use the damper provided in the up-take from the boiler. There is no quicker way of wasting a large amount of fuel than attempting to regulate the steam pressure by opening ash pit doors on hand-fired boilers.

Baffle Walls

In the water tube type of boiler, the flow of gases from the furnace to the breeching is direct by a series of baffles constructed of fire proof material. In removing tubes, and in the normal use of the boiler, these baffles oftentimes become broken and leaky, consequently the gases "short circuit" or do not complete their full path and travel giving high flue gas temperature at the up-take of the boiler and a consequently high loss in boiler efficiency.

Bridge Walls

On water tube boilers, the bridge wall should be carefully maintained, especially at the point where it comes in contact with the first directing baffle, or as it is known to the boiler room force, the first pass. On hand-fired return tubular boilers it was the practice in the past to build the bridge wall up very close to the shell of the boiler on the theory that the flame from the fire would thereby impinge on the boiler surface and give a much better evaporation. This old worn-out theory has been completely done away with. It is found that the relatively cold surface of the boiler chills the gases to a point where they will not again reignite. On the properties of the Iowa Railway and Light Company, this bridge wall is only high enough to keep the coal from falling from the grate over into the combustion chamber.

Careless Firing

This divides itself up into many different phases. With stoker fired boilers the tendency of the firemen is usually to run several short fires rather than two good long full fires on a three-boiler plant and use the third boiler merely for regulating purposes. Owing to the nature of the chain grate stoker a large amount of air enters the furnace from the uncovered portion of the grate causing a very serious loss in efficiency. On hand-fired boilers, the one-shovel method of firing is the best, but the most difficult really to put into effect. The tendency of a fireman is to fill up a furnace and then sit down. This means a large quantity of green fire introduced into the fire and consequently heavy black smoke indicating that a large

amount of unconsumed gases are passing out of the boiler into the stack. I know of one case in a railroad shop where a gang of Greeks were employed as firemen and a rather ingenious master mechanic fixed up a clock which closed a contact, ringing a bell and flashing a red light every 20 minutes. When the bell began to ring and the light to burn, the Greeks all opened the fire doors and proceeded to fill them up. As soon as they had shoveled all the fire boxes would hold, they then sat down and enjoyed a little rest and visit. This was about the most wasteful boiler plant practice that I have ever seen. The banking of boilers also comes under the head of careless firing and it is very difficult to lay down any rule for this. It is simply a case of getting the men interested and seeing just what is the minimum amount of coal that they can bank a boiler with. Fires very clearly show that it is a case of individual effort rather than any hard and fast rule.

Feed Water Temperatures

One of the most common losses in the boiler plant is the failure to maintain proper feed water temperatures. These temperatures can be kept up by keeping the proper amount of steam auxiliaries running around the plant so as to supply sufficient steam to the feed water heater and then at the same time the heater must be kept clean. For example if feed water has been heated to 200 deg. F. each pound of water delivered to the boilers as received is 200 B. T. U. more heat than pumped into the boiler at the average temperature of 60 deg. F., assuming that the boiler pressure is 125 lbs. per square inch. The heat required to make a pound of steam from the original temperature of 60 deg. is 1164 B. T. U., therefore we have saved 200 plus 1164, or 17 per cent of the heat that would have been required for the generation of steam from 60 deg. water and thus the saving directly reflected in a corresponding reduction in the coal consumed. An approximate rule is that 1 per cent of the coal is saved for each 11 deg. rise in the feed water temperature, provided this is accomplished by heat that otherwise would have been wasted or thrown away.

Methods of Building Up Efficiency

I have discussed at some length the various losses and will now give some of the methods outside of better working conditions, that can be applied to building up the efficiency of the boiler plant. Boiler plants should be provided, if water tube, with a first-class high grade tube cleaner and of such a diameter that it will just pass into the tube, otherwise careless workmen will not properly clean the tube if the cleaner is of small diameter and will leave a considerable amount of scale. For cleaning the outside tube surface of a boiler, a very successful method has been developed by the Iowa Railway and Light Company which consists, when the boiler is down for cleaning, of taking an ordinary garden hose and nozzle and spraying water over the outside tube surface. The garden hose nozzle should be so regulated that the water comes out of it in a fine spray or mist. This will pass down through the boiler and soften up the accumulated soot and scale, and at the end of 24 hours, it can be easily knocked off. In cleaning return tubular boilers, a good type of hammer cleaner should be provided and some form of a steam jet soot blower.

The soot blower problem has been quite well worked out particularly for water tube boilers. The soot blower is about one of the cheapest efficiency devices that can be provided. It is, however, necessary to see that they are used regularly on each 8-hour shift and kept in proper repair.

For stopping leaks in settings, a good form of plastic cement should be applied and it has been found very desirable and has been standardized by the Iowa Railway and Light Company, a covering of Johns-Manville cement No. 400, 1½ ins. thick over all of the brick work of the boiler. We have found by actual test that this plastering increases the efficiency of the boiler and cuts down the air leakage giving us a high CO^2 content to the flue gases.

A regular and careful inspection should be made of the ash pit and ash pit doors as before mentioned and whenever a boiler is taken out of service, these pits should be thoroughly inspected.

Dampers

For regulating the boiler, a damper in the uptake flue should be provided. Under no circumstances should the firemen be permitted to regulate by means of the ash pit doors.

Baffle Walls

These should be regularly inspected, using a strong high power electric light in the combustion chamber so that any leaks or cracks can be readily detected by the light shining through. High temperature cement should be applied such as Johns-Manville No. 26 or high tempite for stopping these cracks and leaks.

Arches

Arches on chain grate stokers have received a great deal of attention in the last 18 months and much has been accomplished in its design. In general it may be stated that it is impossible satisfactorily and economically to burn Iowa coal except with a high angle arch. The "sprung" arch, originally introduced into this state, flat and laying down on top of the fire, served but one purpose, that of putting the fire out. In the various power plants of the Iowa Railway and Light Company we have standardized on a 7-ft. arch, having a pitch of 2½ ins. to the foot and setting 13 ft. above the grate at the feed gate end of the stoker. This seems to give the most satisfactory results.

Feed Water Temperatures

In practically every state institution a large amount of steam is used for cooking and heating purposes. The use of steam in the engines of the electric plant is generally a small proportion of the total amount of steam generated by the boiler plant. It is of very great importance, therefore, that all of these drips be so piped up that all of this water is returned to the boiler plant to a hotwell or surge tank so that it can be pumped into the feed water. This water contains a very large amount of heat and besides it is condensed steam and free from scale, whereas raw water taken from wells or rivers is not. It is therefore of great importance that these drips be all returned to the boilers.

From now on the writer will mention certain percentages of fuel saved. These percentages are in weights of coal and not in dollars and cents, for unfortunately in spite of everything that could be done with improved appliances and methods, the coal men have been able to mark up the percentage of price increase faster than automatic devices could bring down the utmost cost, and it should be remembered that these percentages apply to weights of coal and not the cost of coal in dollars.

Boiler Room Appliances

There are many devices on the market, good, bad and indifferent, offered for sale for the purpose of producing economies in boiler room operation. The following named instruments are really commercial, reliable and thoroughly practicable and are named in the order of their importance:

Recording pressure gauge.

Recording thermometers for feed water temperatures.

Draft gauges.

Flow Meters

First for metering the amount of water going into the boilers, and if a further refinement is desired, the boiler flow meter can also be used. This gives an indication of horse power of what each boiler is doing.

Scales for Weighing Coal

With a water meter and weight of coal known, the evaporation, which is the measure of efficiency of the boiler plant, can be readily determined from day to day. This is of the utmost importance.

Automatic Feed Water Regulators

This involves two regulating devices, first the automatic regulator on the boiler for feed water into the boiler as it is needed. The Iowa Railway and Light Company have 47 Copes automatic feed water regulators in daily service and giving excellent satisfaction. These devices we know have reduced our coal consumption from 2 to 5 per cent in the various stations over hand-regulation of boiler feed water. In order, however, to make this device operate satisfactorily, it is necessary to employ on the boiler feed pump a device known as an excess pressure boiler feed line regulator. The function of this valve is to maintain a constant differential pressure between the steam pressure in the boiler and the water pressure in the feed lines, thereby maintaining a constant hydraulic head across the valve of the automatic regulator. Unless this is done, results with the automatic feed water regulator can be even poorer than hand regulation.

Damper Regulators

The damper regulator is a very successful operating device, operated by steam pressure from the boiler which opens and closes the damper in the up-take as the steam pressure in the boiler varies which in turn is a measure of the demand upon boiler plants. There are many satisfactory forms of damper regulators. We have, on the Iowa Railway and Light Company standardized the Mason No. 8 automatic damper regulator.

In general it may be stated that stoker firing is applicable to plants of 200 horse power boilers and above. Below this the size of the stoker becomes so small that it is anything but economical and a good hand-fireman can give better results than the stoker. Above 200 horse power, however, it is difficult to get men to handle boilers by hand on account of the effort and work required in doing it with the result that the boilers are filled full of

coal periodically and the fuel results are very poor. Furthermore, the automatic stoker is a means of reducing labor.

Coal and Ash Handling Plants

Another very fruitful source of labor wasted around power plants, is due to improperly designed coal and ash handling systems. Too much attention and consideration cannot be given to this problem in both old plants and new plants that may some day be built.

The foregoing matter is from a paper by Mr. Drabel in a recent issue of the Iowa Bulletin of State Institutions.

MAXIMUM DEMAND CONTROLLER FOR LARGE WATER CONSUMERS

By E. C. Mayer, of Geo. H. Gibson Co., Consulting Engineers, Tribune Bldg., New York, N. Y.

Some water supply systems are required to furnish an adequate minimum pressure for fire protection. If they also have one or more large consumers, whose demands are so great as to equal nearly the pipe line capacity, the pressure available for other purposes may be reduced seriously.

This condition is graphically represented by Fig. 1, wherein the pressures at communities A and B are at times too low because the large water consumer at the end of the line is drawing full pipe capacity.

The pipe line can, however, furnish the full amount needed by the large consumer without affecting the pressures at A and B if the large quantity of water be delivered at a reasonable rate. For this purpose, a maximum demand or rate of flow controller, made by the Simplex Valve & Meter Company, Philadelphia, and illustrated in Fig. 2, has been developed. It prevents the drop in pressure due to excessive peak demands on the water supply line.

When the controller is installed, the minimum hydraulic gradient experienced is represented by the upper gradient line in Fig. 1.

The maximum demand controller remains open at the predetermined setting until the rate of flow reaches the prescribed maximum. From this point on, the opening of the controller is just sufficient to permit the specified rate of flow, and no more, to take place.

The controller can be by-passed in case of an emergency, and the line permitted to deliver its full capacity. Two maximum demand controllers can be arranged in parallel, each one carrying half of the full amount of flow. Either of the two controllers may be used separately to supply the demand.

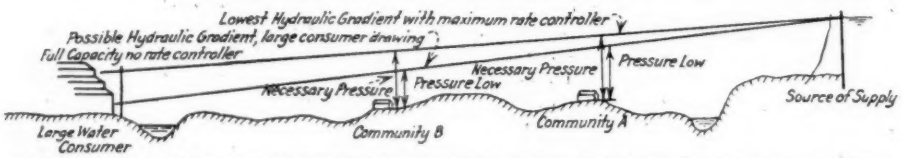


FIG. 1—HYDRAULIC GRADIENT IN A WATER SUPPLY SYSTEM BOTH WITH AND WITHOUT A MAXIMUM DEMAND CONTROLLER INSTALLED.

The principle of operation of the maximum demand controller is readily understood by referring to Fig. 2. Briefly, it consists of a Venturi Tube with the discharge flange connected to a valve body provided with a double-disk-type balanced valve. The valve stem is guided in the upper and lower covers, engages a diaphragm near the bottom of the valve

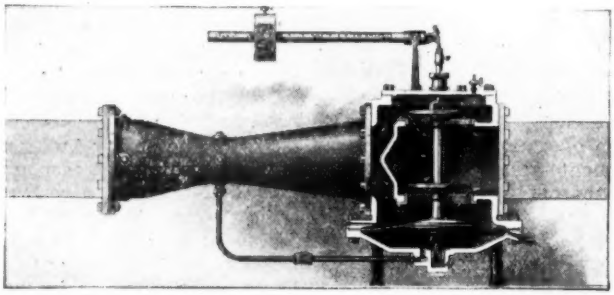


FIG. 2—SECTIONAL VIEW OF THE SIMPLEX MAXIMUM DEMAND CONTROLLER.

body, and at the top is attached through a flexible connection to the short arm of a lever or scale beam.

For any given rate of flow, there exists a certain difference between the water pressure in the valve body and that in the throat of the Venturi tube, due to the difference between velocities at these points. The downward pressure on top of the diaphragm is greater than the upward pressure below, and for this reason there is transmitted to the short arm of the scale beam a downward pull that is balanced by the counter-weight on the longer arm of the scale beam. This balance of the counter-weight and diaphragm load limits the maximum rate of discharge through the controller. This fact is obvious, since, if the rate of flow should momentarily increase beyond the allowable maximum, the diaphragm load would also increase, thus diminishing the valve opening until the balance is automatically restored.

Altering the position of the counter-weight on the longer beam arm changes the maximum permissible rate of flow.

The maximum demand meter illustrated employs a Venturi Tube which can also be used in connection with a metering device for purposes of indicating, recording, or registering the flow.

WATER WORKS REPORTS AND WHAT THEY SHOULD CONTAIN

By Robert E. McDonnell, of Burns & McDonnell Engineering Co., Interstate Bldg., Kansas City, Mo.

Some water works superintendents, and occasionally city officials, may question the value of a water works report and doubt if its cost is money well spent. The answer to this question is simple. It depends upon the report.

One of my favorite indoor sports is to examine water works reports; the good ones being read with much interest and filed for frequent reference and the bad ones being consigned to the waste basket.

Water works reports reflect exactly what the superintendent or manager is. Invariably a good superintendent issues a good report. When one examines, as I have recently, a report that contained page after page of fire hydrant locations, and another report where pages were devoted to statistics 15 to 20 years old, it doesn't require an efficiency expert to figure out the loss and waste of time and money by issuing such a document. The printer's proofreader was probably the only person who read the entire document. My criticism of water works reports comes from reading them and, therefore, from the standpoint of the consumer, I am going to mention briefly a few features of reports that have made them especially interesting to me.

Why Should a Report Be Made?

A water plant is one of the chief assets of a city; in value it ranks well toward the top of all the city investments, whether owned by the city or company. The success and continued operation of all other industries, factories, etc., are dependent entirely upon the water works. The health, growth and prosperity of the city are entirely dependent upon the purity and cleanliness of its water supply. Its customers extend over the entire city; its commodity is standardized and is of one quality. When city owned, every citizen of the town is a stockholder and, therefore, a report to the public is due; and the public, further, has a right to demand a real water works report in keeping with the importance of the utility.

Appearance of Report

Reports, like people, are often judged by appearances and, therefore, it should have an attractive cover and be of a good quality of paper and printing. Like a girl's skirt, it should be long enough to cover the subject, yet short enough to be interesting. The pictures accompanying a magazine article always produce a desire to read the article and photographs and cuts should be freely used to relieve the monotony in text and statistics.

What It Should Contain

A brief historical sketch, giving date of purchase or date when built and the present value of the property, is always of interest to new customers.

Statistics themselves are rarely read by the layman and these should be converted into graphical diagrams, which are understood at a glance.

A concise tabulation of operating costs, annual revenue, fuel costs, increase in number of connections, etc., shown both by figures and graphical charts, are always interesting and these should not cover more than a ten-year period, as old statistics are of little interest or value.

A population curve and water consumption curve are always well worth the making, as it shows what future provision for growth should be made.

A plain statement from health authorities regarding purity of water, with per-

centage of bacteria removed, with cuts or illustrations of bacterial comparison of raw water and treated water, is the best kind of advertising a report can contain, for one must not forget that his business is selling water and the reports help sell the customer. People always like to know how their money is spent and a graphical diagram showing what part of a dollar goes for interest, labor, fuel and operation, is enlightening.

Illustrations showing losses by leaky faucets, bad plumbing and unregulated flush tanks or sewers, are helpful in bringing about reforms. Showing customers how much their own bills could be reduced by eliminating all wastage, is convincing.

The reduced pumpage, reduced fuel or power bills and increased revenue by universal meter system are features that can and should be shown in every water works report, for even in this enlightened day we find a few communities who still sell, or rather give water away, without meter measurement.

The city, corporation or individual doesn't exist that can make a success of selling any commodity without measurement of the amount sold. The report should show or account for the loss between water delivered and water sold, and if this doesn't show a yearly improvement, something is radically wrong and needs correction.

A water works plant is never finished or completed and the needed extensions, betterments and improvements ought always be prominently shown in a report, then there are no shocks or surprises, and if bonds are needed there is nothing gained by concealing the fact. Show in the report why the improvements are needed and what advantages and results will be gained by them.

Every report ought to show the cost of delivering water per 1,000 gals., including interest, depreciation, sinking fund reserve, etc. This information is not always known by the superintendent himself and when he figures it out, he will, in many towns, find that large users, railroads especially, are getting their water at less than its cost of production. When one glances at his own railroad and Pullman expenses these times, it causes the reflection that railroads ought to have sufficient funds available at least to pay for the cost of furnishing water. In these days of regulation of rates, one cardinal law acknowledged by all is that the rates of each utility, whether a water plant, light plant, or railroad, should be based on its value and cost of operation. The railroads or other large users are not institutions, with rates made because of their being a special aid or help to a town. Every report should show what the rates should be to earn this interest, depreciation and operating expenses.

Value of a Report

A report is of much advertising value to the entire community, so much so that many commercial clubs are joining in the expense of printing and circulating water works reports. Every live water works superintendent knows the advertising value to himself of getting out a good report. It places him in a favorable light before many other communities, where opportunities for advancement exist.

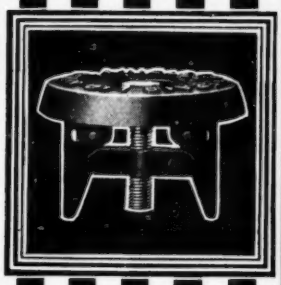
The educational value is of greatest importance. It acts as an aid in getting bonds for needed improvements, as a basis for argument for equalizing rates or in securing a raise of rates it is of much value.

How Presented

A report to be of any value must be interesting, for if not interesting it will never be read. The author of the report or some water works official should personally present a resume of his report before every civic organization of the town, not omitting the women's clubs.

In Glasgow, Scotland, which city prides itself on being the best governed city in the world, the head of each utility or department is required to give at a mass meeting a public accounting of his utility. For example, the water department head gives the workings of the department, its needs, etc. I listened one night to an address by Thosmas Melvin, manager of the sewerage department, on the subject of "The Cleansing of the Clyde River." He told how the Clyde River had been transformed from a foul sewer-like stream to a beautiful river, abounding in fish and lined with house boats. The lecture, or really his report, was illustrated with slides and was of much interest. These reports, thus presented, kept before the public their needs and caused a keen interest in their own utilities. Extracts from reports are desired by the local papers and should be given them. Send each customer one by the meter reader, or hand them out by the window collector. Exchange your reports with the officials of other cities of your state.

The water works plant is the chief asset of the city, but the lack of general



MUELLER
Improved Extension Service Boxes

This MUELLER improvement over the old type screw adjustment box, permits the raising or lowering of the upper section without injury to the curb cock or service.

The large case insures stability — the lid is practically indestructible—yet the materials used give excess strength coupled with lighter weight—effecting a decided saving in freight.

Made with 1¼", 1½" and 2" upper sections, they will accommodate a range of water or gas curb cocks from ½" to 2", as desired.

MUELLER Service Box Repair Lids are easily attached, and when applied make the old box better than it was originally. Many new boxes are now ordered equipped with MUELLER Repair Lids.

Write for full description and prices.

Mail orders given prompt attention.

H. MUELLER MFG. CO., Decatur, Ill.
PHONE BELL 153
Water, Plumbing and Gas Brass Goods and Tools
New York City, 145 W. 30th Street
Phone Watkins 5397
San Francisco, 635 Mission Street
Phone Sutter 3577
Sarnia, Ontario, Canada

Mueller Metals Co., Port Huron, Mich., Makers of "Red Tip" Brass Rod; Brass and Copper Tubing; Forgings and Castings in Brass, Bronze and Aluminum; Die Castings in White Metal and Aluminum; also Screw Machined Products.

knowledge concerning it is a fault we can largely correct by getting out and presenting a genuinely interesting report. Whether it pays or not depends on the report and its presentation.

The foregoing paper by Mr. McDonnell was presented at the 1921 meeting of the Southwest Water Works Association.

MEASURING DEPTH TO WATER IN WELL

To the Editor:

I note on p. 195 of your May, 1921, issue, description of apparatus for measuring deep well, by Lawrence W. Cox, of Des Moines, Iowa, which he developed in 1915.

I am sending herewith description of apparatus which I have used since 1911 or 1912. We have used this tester on depths as high as 300 ft., where a space of about 1 in. between the drop pipe and the well was available.

Thought you would be interested in knowing about this, as it antedates the one described in your May issue.

Very truly yours,
CHARLES BROSSMAN,
Consulting Engineer.

Merchants Bank Bldg.,
Indianapolis, Ind., May 31, 1921.

The apparatus to which Mr. Brossman makes reference is herewith illustrated and described:

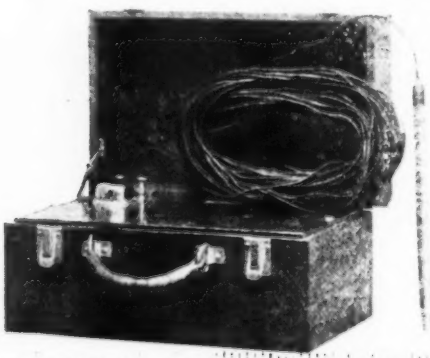
The Well Tester

The instrument is used to find the level of water in deep wells. It can be used to measure the depth of water below the surface while pumping or while running tests or to measure the static head in the well.

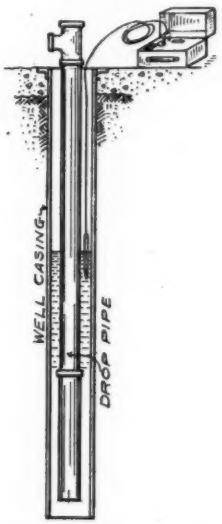
In making tests of deep well pumps it enables one to know exactly where the water stands in the well for any quantity pumped. It enables one to keep track of the condition of wells and strainers by showing the level of water. Good wells are often discarded because their condition is not known.

How the Well Tester Is Used

The contact tube is lowered into the well between the drop pipe and well casing. On being immersed in the water the buzzer on the battery box will be thrown into circuit. There should be 11/16 in. space between the drop pipe and outside of well. As the water lowers in the well the tester is also lowered to maintain contact with the water.



INSTRUMENT TO MEASURE DEPTH TO WATER IN WELL.



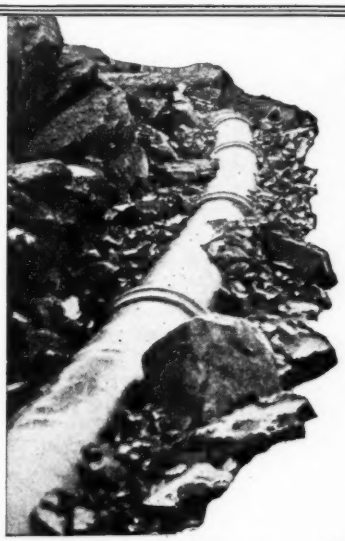
SKETCH ILLUSTRATING USE OF WELL TESTER.

WHAT HAPPENED IN A "ONE MAN" WATER PLANT

By J. F. Christy, Manager City Water and Light Plant, 106 W. Washington Ave., Jonesboro, Arkansas.

(Editor's Note.—The following useful illustration of the unwisdom of a too highly centralized utility operating organization is from a paper by Mr. Christy before the Southwestern Water Works Association.)

There was once a man who had direct charge (as chief engineer) of the operation of a reasonably large water works plant; he was an excellent fellow personally and was very well posted; he had acquired his knowledge by hard knocks



Bell and Spigot Joints Cast Iron Pipe

This type of joint is flexible enough to allow for the expansion and contraction of a line under temperature changes. Long easy curves may be laid without specials. No iron-to-iron joints to rust together, forming a rigid line always to be avoided in exposed installations.

United States Cast Iron Pipe & Foundry Co.

General Office, Burlington, New Jersey

SALES OFFICES:

Philadelphia: 1421 Chestnut St. Chicago: 122 S. Michigan Blvd. Minneapolis: Plymouth Bldg.
Pittsburgh: Henry W. Oliver Bldg. St. Louis: Security Bldg. Cleveland: 1150 E. 26th St.
New York: 71 Broadway Birmingham: 1002 American Trust Bldg. Buffalo: 957 E. Ferry St.
San Francisco: Monadnock Bldg. Dallas: Scollard Bldg.

STEWART SEWER CLEANING MACHINE

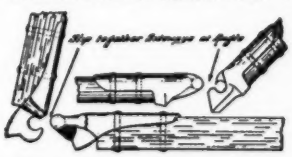
Water Cleaning System, if you wish it, or Drag Bucket type.

Also have TURBINE SEWER CLEANING MACHINE at Low Price.

WE WILL PAY FREIGHT AND CHARGE TO BILL.

We Ship Rods for Trial—who else will do this?

We also make a Rod that will float. Also Rods with wheels for conduit work.



SEWER AND CONDUIT RODS

No Deep Shoulder Cut for Couplings. Rods retain full size and strength.

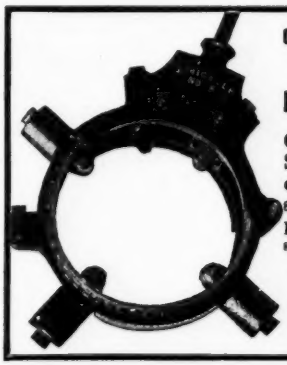
Investigate our JUMBO ROD

W. H. STEWART

1614 Locust Street . . ST. LOUIS, MO.
129 George Street . . BOSTON, MASS.

CANADA FACTORY, WALKERVILLE, ONT.
Therefore No Duty for Purchaser to Pay.

PACIFIC COAST DELIVERIES MADE FROM SAN FRANCISCO.



CUT that NEXT JOB with a

STRICKLER

Ratchet Pipe Cutter

Cuts either Cast or Steel pipe. Cuts a channel in the pipe same as a lathe cut.

Each size cuts a range of sizes. Catalog on request.

W. W. STRICKLER & BROS.
COLUMBUS, OHIO.

American Cast Iron Pipe Company

Manufacturers of

BIRMINGHAM, ALA.

Sales Offices:

Birmingham, Ala. . . . . Box 908
Columbus, Ohio . . . 607 New Hayden Building
Minneapolis, Minn. . . . 712 Plymouth Building
New York City . . . . . No. 1 Broadway
Chicago, Ill. . . 512 First National Bank Building
Dallas, Texas . . . . 1217 Praetorian Building
Kansas City, Mo. . . . . 716 Scarritt Building
San Francisco, Cal. . . . . 711 Balboa Building
Los Angeles, Cal. 339 Citizens National Bank Building

and long experience. The men under him were apparently competent and his production cost seemed to be satisfactory to his superiors.

Only by intimate association and close observation was it discovered that here was a case of one man endeavoring to attend to all the details in connection with the plant operation. No one about the power house had the slightest authority, excepting himself; he required the night crew to report to him as well as those who worked in the day time. He learned thoroughly the operating characteristics of each new piece of equipment as it was installed, and understood his older machines as a mother does her child, but he never imparted any of his knowledge to his men. He wanted to be supreme in authority, he wanted to be called upon to straighten out things in times of trouble; he prided himself upon being called out, at all hours of the night, to correct mistakes, to remedy accidents, or to repair trouble that any properly instructed operator should have avoided, or at least taken care of without assistance.

This man had the mistaken idea that so long as he himself understood his plant thoroughly all would be well.

Each year when this chief engineer took his vacation, the plant operation was supervised by an assistant engineer. It so happened, on one occasion, that an accident occurred which should not have resulted seriously; but in consequence of the ignorance of the operator who was on duty at the time (and who had not his chief to call upon) a mistake was made which brought about a catastrophe that cost the company thousands of dollars to say nothing of the lost revenue and inconvenienced patrons.

As soon as normal conditions were restored, the supervising engineer instituted an investigation to determine the cause of the calamity. He soon discovered that lack of sufficient knowledge alone, on the part of the operator, had been the direct cause, and much to his surprise he found that none of the other operators was any better informed.

When his report of the disaster with its inexecusable cause and other findings was noted to his superiors an upheaval resulted. The young supervising engineer was put in charge of the power plant and the old chief, upon his return, was relieved of his duties forthwith.

The new chief immediately proceeded to instruct his men; every man was placed in the position for which he was best suited and soon learned all there was to know about his work. Up to the present time, after several years have elapsed, there has been not the slightest kind of a shut down and no serious trouble in that plant. The young chief has his men well trained now and devotes only a small portion of his time to the plant operation; in fact, he is also maintaining most of his former work in the engineering department. By properly instructing and training his operators, he greatly increased their efficiency, and has materially reduced production costs.

WATER PURIFICATION FOR TOWNS ON TIDAL RIVERS

The method by which Uncle Sam, acting through the U. S. Public Health Service, purifies the drinking water for his model village and reservation at Perryville, Md., though not altogether new, carries some interesting lessons for the country at large and particularly for towns situated along tidal rivers.

The raw water, which is pumped from the Susquehanna River through 30-in. mains to settling tanks, is subject to rapid changes in turbidity ranging from 10 to 100 parts per million; and the amount of aluminum sulphate to be added as a coagulant and precipitant must be varied to suit. Samples of the water entering the mains are taken every two hours; and the amount of coagulant to be added is determined by the chart based on the amount of water and its turbidity; for instance 0.6 grain of the alum is added for 10 parts per million of turbidity. This amount, however, is also governed by the alkalinity, which may vary greatly during the day; when it drops below 14 parts per million, soda ash is added.

Two hours are allowed for settlement in the tanks, after which the water flows by gravity through mechanical rapid sand filters, passing through 3 ft. of sand and 8 ins. of stone and gravel at the rate of 2 ins. in 55 seconds. Later the water is treated with liquid chlorine, the amount depending on bacteriological examination of the raw and the chlorinated water. This treatment reduces the bacteria from an average of 2,630 (maximum 7,860) per cubic centimeter to less than one.

The condition of the water at Perryville is affected by the geological formation of the country, by the daily conflict of the tide and the river current, and by the strong winds which often cause terrific wind action on the low flats, all of which necessitate very effective treatment.

Engineers' and Contractors' Directory

JOHN W. ALVORD :: CHAS. B. BURDICK
Consulting Engineers
Water Supply Sewerage Water Works
HARTFORD BUILDING, CHICAGO, ILLINOIS.

THE AMERICAN APPRAISAL COMPANY
A Quarter Century of Service
Chas. W. McKay, Engineer Public Utilities Department
MILWAUKEE—CHICAGO—NEW YORK
APPRAISALS RATE INVESTIGATIONS
FINANCIAL REPORTS

Wm. Artingstall
Civil Engineer
WATER SUPPLY SEWERS SEWAGE DISPOSAL
Old Colony Building Chicago

CHAS. BROSSMAN
CONSULTING ENGINEER
Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Reduction in Operating Cost. Appraisals—Expert Testimony.
Merchants Bank Bldg. INDIANAPOLIS, IND.

BURD & GIFFELS
CIVIL ENGINEERS
POWER DEVELOPMENTS WATER SUPPLY
SEWERAGE
KELSEY BUILDING GRAND RAPIDS, MICH.

CHICAGO PAVING LABORATORY
L. Kirschbraun H. W. Skidmore
CONSULTING and INSPECTING ENGINEERS
PAVEMENTS and PAVING MATERIALS
Consultation, Design, Specifications, Reports, Testing, Inspection and Research.
160 North Wells Street CHICAGO

CITY-WASTES DISPOSAL CO.
(Organized from Staff of Col. Geo. E. Waring, Jr.)
Consulting Engineers. Specialists in Drainage, Sewerage and Sewage Disposal. Preliminary Investigations and Estimates, Surveys, Plans and Supervision. Sanitary Examinations and Reports.
45 Seventh Ave. NEW YORK.

DOW & SMITH
CHEMICAL ENGINEERS
Consulting Paving Engineers
A. W. DOW, Ph. B., - Mem. Amer. Inst. Ch. Engrs.
F. P. SMITH, Ph. B., - Mem. Amer. Soc. Civil Engrs.
Asphalt, Bitumens, Paving, Hydraulic Cement, Engineering Materials
131-3 E. 23rd Street NEW YORK CITY

FARGO ENGINEERING CO.
ENGINEERS
Water Supply. Steam and Hydraulic Power Plants. Advice as to Reduction in Operating Costs. Reports and Estimates for Bond Issues.
212 W. Cortland St. Jackson, Mich.

WALTER H. FLOOD & CO.
PAVING LABORATORIES
Plant and Street Inspection. Testing and Inspection of Materials.
Offices: 22 Quincy St. Laboratories: 742 E. 39th St.
CHICAGO, ILL.

Farley Gannett Theodore E. Seelye Samuel W. Fleming, Jr.
GANNETT, SEELYE & FLEMING, Engineers
204 Locust St. Harrisburg, Penna. 10th Floor Ariel Bldg. Erie, Penna. Randolph Bldg. Memphis, Tenn.
All branches of Municipal Engineering, including City Planning, Paving, Water Works, Sewers, Sewage Disposal, Preliminary Reports and Estimates of Cost for Bond Issues. Valuation of Public Utilities for Rate Making and Purchase. Water and Sewage Analysis.

Nicholas S Hill Jr S. F. Ferguson
HILL & FERGUSON
CONSULTING ENGINEERS
WATER SUPPLY—SEWAGE DISPOSAL—HYDRAULIC DEVELOPMENTS.
Reports. Investigations Valuations Rates. Design Construction Operation Management.
Chemical and Biological Laboratories.
112 E. 19th Street New York City

J. W. HOWARD
CONSULTING ENGINEER
ROADS AND PAVEMENTS
Laboratory Analyses and Tests. Specifications improved.
Expert in Valuation and Litigation. 32 years' experience.
1 Broadway NEW YORK CITY

ROBERT W. HUNT & CO., Engineers
Inspection — Tests — Consultation
PAVING MATERIALS, CAST IRON PIPE, STEEL AND CEMENT
Chemical Cement and Physical Laboratories
2200 Insurance Exchange CHICAGO, ILL.

SAM L. JONES, Consulting Engineer
PAVEMENTS and ROADS
Specifications, Estimates and Cost Systems
807 Second Nat'l Bank Bldg. CINCINNATI, OHIO

W. G. KIRCHOFFER
Sanitary and Hydraulic Engineer
Water Supplies Water Purification Sewerage
Sewage Disposal Land Drainage
22 N. Carroll St. MADISON, WIS.

DAVID MACNAUGHTON
CONSULTING ENGINEER
ELECTRIC AND WATER UTILITIES
Appraisals, Reports, Investigations, Valuations, Rates and Design Construction.
Central Building FORT WAYNE, IND.

ALEXANDER POTTER, C. E.
HYDRAULIC ENGINEER AND SANITARY EXPERT
50 Church St., New York City
Sewerage and Sewage Disposal, Water Supply and Purification, Water and Electric Power.
Valuations of Existing Plants where MUNICIPAL OWNERSHIP is Contemplated—Expert Testimony—Plans and Estimates.

ASTRID S. ROSING, Inc.
Sewer Pipe—Drain Tile—Steam and Electric Conduits—Building Tile—Fire Brick
Harris Trust Building, CHICAGO, ILL.

W. S. SHIELDS
CONSULTING ENGINEER
Municipal Improvements. Water Supplies and Water Works Systems. Sewers and Sewage Disposal. Pavements and Roads.
Hartford Building. CHICAGO, ILL.

HERMAN STENSRUD
MARQUETTE, MICHIGAN.
Trenching for Water Mains, Shallow Sewers or Drainage, by lineal foot or by day.
Machine—Buckeye, gasoline driven, cutting two feet by six feet.

SULLIVAN, LONG & HAGERTY
GENERAL CONTRACTORS
Builders of Sewer Systems and Water Works Plants
Home Office, BESSEMER, ALA.

Testing, Consultation, Bitumens, Paving, Inspection, Specifications, Asphalts, Road Oils.
ISAAC VAN TRUMP
ENGINEERING CHEMIST
2337 South Paulina Street. CHICAGO, ILL.

JAMES P. WELLS, HYDRAULIC ENGINEER
Surveys, Estimates of Cost of Proposed Work, Reports on New Improvements, Preparation of Plans, Supervision of Construction, Dams and Reservoirs, Pipe Lines, Filtration Plants, New Water Supply Systems, Hydro-Electric Power Plants.
Main Office, 249 Cutler Bldg., Rochester, N. Y.
Chicago, Ill. New York City. Knoxville, Tenn. Toronto, Ont.

CHLORIDE OF LIME
FOR PURIFYING WATER
PENNSYLVANIA SALT MANUFACTURING CO.
Widener Building PHILADELPHIA, PA.

SLUICE GATES
Sheer, Flap and Butterfly Valves
FLEXIBLE JOINTS
COLDWELL-WILCOX CO.
South Water St. NEWBURGH, N. Y.

DIRECT OXIDATION PROCESS
Apparatus for carrying out this Process for Sewage and Water Treatment supplied upon Engineers' specifications.
DIRECT OXIDATION PROCESS CORPORATION
15th and Lehigh Ave. PHILADELPHIA, PA.

VALVES & FITTINGS — FLOWER COMPANY — DETROIT, MICH.
DETROIT FILTRATION PLANT LARGEST IN THE WORLD
FLOWER HYDRAULIC AND HAND OPERATED VALVES, SLUICE GATES, SPECIALS, ETC., ASE USED THROUGHOUT THIS SIX MILLION DOLLAR PLANT.

STANDARD AND HIGH PRESSURE FIRE HYDRANTS	CAST IRON, STEEL AND BRASS VALVES
SLUICE GATES	FILTRATION SPECIALS
TAPPING VALVES AND SLEEVES FOR WATER AND GAS TAPPING MACHINES	CAST IRON AND STEEL FITTINGS
FABRICATED STEEL PIPE	GRAY IRON CASTINGS

Construction News and Equipment

ECONOMIC CHOICE OF ROAD CONSTRUCTION PLANT UNITS AND LAYOUTS

By B. H. Piepmeier, Engineer of Construction, Illinois Division of Highways, State House, Springfield, Ill.

Successful road work offers more possibilities for different types of plants than perhaps any other single line of building construction, and every section of road to be built is a field for intensive study and investigation by the engineer and contractor. A thorough examination of the road plants in operation for the past few years shows clearly the need of more careful study of plant problems than is ordinarily given by engineer or contractor.

Past Conditions Favorable to Small Plants

In general, the building of a system of roads requires the installation of a number of small plants in preference to a few large plants. This has been particularly true in the past on account of (1) the contractor's inability to secure experienced and capable superintendents for handling large-plant operations; (2) railroad transportation falling short in the delivery of sufficient materials to keep large plants working efficiently; and (3) frequent breaking of the machinery required in large road-construction plants—the break-down of one machine very often delaying the entire plant operations and causing undue expense.

The small construction unit necessitates doing many operations by hand at somewhat greater expense than if done with machinery; however, when the final analysis is made, the small unit will show considerable efficiency on account of the possibility of its operating many times independent of any one particular machine out of service through breakdown.

Normal Conditions Favorable to Large Plants

Conditions existing during the past few years have made it impossible for the contractor with a large plant layout to show a fair profit. As soon as labor and transportation conditions become more stabilized, the large plant will show a much greater efficiency.

Often Economical to Duplicate Machines

Contractors must give considerably more thought to the design of road plant so that its successful operation may not be wholly dependent upon one piece of machinery. Many successful road contractors realize already that to insure a constant and uniform output, it is economy in many instances to duplicate machines. Some contractors have installed a duplicate pumping system for the water supply, which is vital to the successful and economical operation of the road plant, and the additional cost of the duplicate unit is small compared to the advantage of being able to operate the plant without a delay.

In many instances duplicating concrete mixers has prevented a complete shutdown of operations. The average road job may not always justify a duplication of the mechanical units, but where a large season's work is required, a serious investigation of the advantage of the duplicate units should be made.

Transportation Problem in Road Building

The transportation problem in road building is one of the most important factors in the economical construction of roads. Consequently this part of the plant operation should be given a great deal of study. The transportation cost should not only be estimated on the basis of the ton-mile cost but the effect it may have on the cost of operation of the remainder of the construction plant should be taken into consideration. Hauling cost varies from 20 to 40 cts. per ton-mile. In a season's work a saving, therefore, of but a few cents per ton-mile may amount to several thousand dollars. The actual hauling costs may be exceedingly low, yet if the delivery affects the maximum output of the remainder of the plant, the inefficiency of the plant should naturally be charged against the transportation cost.

Industrial Railway or Truck

Inasmuch as most specifications now prohibit storing road materials upon the subgrade, the road contractor is compelled to provide for transportation in one of two ways. He must deliver ma-

(Continued on page 24)

Bids thrown

Contractors Spotlighted as Greedy Grabbers by the Public Press

AND, in the greatest number of instances this deplorable accusation is unjustified—due to misconceptions and misunderstandings.

One of the causes, the Koehring Company believes, is the injudicious advertising of day-run mixer "records."

Such "records," of course, as every contractor and engineer understands, are not common, are not average performances, not representative, and not ***possible,*** except under extremely fortunate combinations of circumstances peculiar to particular jobs.

Yet, don't forget that these exceptional records are likely to be used as a basis for "checking" up on "bids" and cost figures. They are misleading to public and inexperienced estimators.

95% of road work is under average conditions, not more than 5% under conditions where record yardage results are possible.

To put the spotlight on yardage records of the 5%, the Koehring Company believes to be bad for business—bad for the industry.

The Koehring Company refrains from featuring the remarkable Koehring records in its advertising—because such records are misleading to contractors who will do 95% of the jobs under average conditions—and because, under present conditions, it is harmful to the industry.

KOEH

In writing to advertisers please mention MUNICIPAL AND COUNTY ENGINEERING

out! Work held up!

Now, to forestall the skeptic, if there is one who might believe that the Koehring paver has made no remarkable records, here are the figures of G. P. Scharl, Muskegon, Mich., with a Koehring 28-E Paver, on a 7x8-inch, 18-foot road, one-minute mixing time.

April 28—1105 lineal ft. in 9 hrs.
April 30— 800 lineal ft. in 7½ hrs.
May 11—1240 lineal ft. in 9 hrs.
May 20—1304 lineal ft. in 9 hrs.

Beyond all question Mr. Scharl, and the Koehring paver, hold the world's records—and Koehring yardage records will be confidentially given to contractors and engineers, with permission of contractors making them—but, except in the instance of this advertisement, such records will be eliminated from Koehring advertising for the good of the contractor, and the industry.

After all, we are frank to say that day-run records do not express true mixer value, either of the Koehring or any other mixer. It's the **season's yardage** that counts—the ability of a mixer to stand up under top speed operation, to handle all the materials brought to it, under all conditions, and to do it without breakdowns and delays—and these are reasons why we call the Koehring the **heavy duty, extra yardage mixer**—the mixer of longest service life.

Koehring Capacities

PAVERS—7, 10, 14, 21, 28 cu. ft. mixed concrete. Steam and gasoline, boom and bucket or spout distribution, multi-plane traction, power discharge chutes.

KOEHRING HEAVY DUTY CONSTRUCTION MIXERS—10, 14, 21, 28 cu. ft. mixed concrete. Power charging skip, batch hoppers, steam and gasoline.

KOEHRING DANDIE MIXERS—4 and 7 cu. ft. mixed concrete; steam or gasoline, low charging platform, power charging skip, automatic water measuring tank, and light duty hoist. The dependable light mixer for culverts, footings, etc.

RING

THE KOEHRING COMPANY
• • •
MILWAUKEE WISCONSIN

(Continued from page 21)

terials from his material yard to the road by industrial railroad equipment or by truck. The industrial equipment, while expensive in first cost, will enable the contractor to complete his work with a minimum amount of trouble under normal conditions and regardless of weather. The average industrial equipment will insure a more uniform delivery of materials than any other unit that may be used. The chief objection to the industrial unit is that it is limited to road construction with grades ordinarily less than 4 per cent and a minimum number of railroad crossings. Further objection would be that the high initial cost demands a large mileage of roads be built each year in order to absorb the interest on the investment and the depreciation.

The other method of delivery is by truck or team. In recent years truck delivery has superseded team delivery, being more rapid and delivering material to a paving mixer or from a mixer direct to the road with less disturbance to the road-bed. Truck transportation of road materials is very flexible and therefore suited to more different sections of work than perhaps any other method of transportation. It is especially suited to the delivery of mixed concrete from a central plant to the road being improved, and to the delivery of proportioned batches direct to the paving mixer or to a point at which the batch boxes may be transferred to a short industrial line which in turn delivers them to the paving mixer.

Delivery of Mixed Concrete

During the past few years the delivery of mixed concrete from a central mixing plant direct to the job has been attracting considerable attention. This method is worthy of study, as it enables the contractor to centralize operations and in many instances to economize in plant and operating expenses. The central mixing plant should be reasonably uniform in design and simple in operation. A study of the central mixing plants in use during the past two years shows no two very similar in design. It would seem possible that unloading aggregate and cement from railroad cars, mixing the materials to the desired proportions and consistency and turning out a mixed concrete, could be standardized to such an extent that central plants could be simplified and made more economical in operation. It is hoped that the mechanical engineer and the equipment designer will assist in the design of a practical and economical central-mixing-plant unit.

Although central mixing plants may be fairly uniform in design, the delivery of the concrete from the plant to the road will vary considerably to suit the existing local conditions. Mixed concrete may be delivered by industrial equipment, provided the hauls are reasonably short and the equipment is designed for small loads with considerable speed in transportation. The small pneumatic-tired truck will usually prove the most efficient machine for delivery of mixed concrete, taking the individual batch of mixed concrete direct from the mixer to the road being improved in the least possible time here.

The Pneumatic-Tired Truck

The pneumatic-tired truck is essential when speed is an important factor in delivery and where it is necessary to do considerable hauling over the subgrade. This truck will usually reduce the load on the subgrade to less than 125 lbs. per sq. in. of surface, and it has been found that this pressure, even though frequently applied, does not seriously injure or displace a prepared subgrade having average soil conditions.

It is true that it is practically impossible to deliver materials over earth roads with trucks when the roads are muddy or during rainy periods. However, the road may be materially improved and the truck used practically the entire construction season if the road is constantly maintained by the use of the road drag and given an application of half a gallon of oil per square yard surface early in the construction season.

The light pneumatic-tired truck may also be used for the delivery of proportioned batches of aggregates direct to the paving mixer on the road being improved. There are now on the market many types of batch boxes and dump bodies which permit the batches to be dumped directly into the skip of the paving mixer. This method has proved to be very satisfactory. It differs from the delivery of mixed concrete in that a paving mixer is used instead of a stationary building mixer, and most of the operations of the contractor are out on the job where the road is actually being laid.

It seems possible that a very material improvement can be made in the present railroad transportation equipment. Practically all road contractors now unload aggregates from open-top cars by means of clam shells. This method is not always the most economical, but the contractor is forced to use it, as he cannot secure all hopper-bottom cars he might desire. On account of the large

"Old Bess Needs No Sleep!"

OUT in the Sacramento Valley of California four P & H Excavator-Cranes working 24 hours a day digging irrigation and drainage ditches, sunk into four to six inches of water, handled as much as 22,000 yards of dirt a month.

In the south San Joaquin Irrigation District, near Manteca, two P & H Excavators dug and cleared the ditches. Merced County used them for unloading crushed rock and gravel from cars for the county highways.

A. E. Conell, county engineer, Livingston, unloaded eight cars of rock and sand in a day, stock piles along the track.

All the levees and filling walls for the flood control project at Long Beach was accomplished by the United Dredging Co. through a P & H "Old Bess" (as this reliable excavating, handling, and power crane is often called), tore up the old concrete roads, graded, made cuts and fills, built approaches to new bridges, working continuously day and night, month after month. It earned its cost many times over on this one job alone.

Peter Ferry, constructing a highway at Harbor City, California, used a P & H in a similar manner. First, "Old Bess" graded, built approaches, cut and filled. When surfacing was started, she was run to the siding to unload rock and sand from cars to bunkers. Measured batches were lifted from trucks to paver later.

The Los Angeles County Flood Control District is also using a P & H to complete the canals and laterals to take off the flood waters.

EXCAVATING MACHINERY DIVISION

PAWLING & HARNISCHFEGER CO.

In Milwaukee, Wisconsin, Since 1884

New York: 50 Church St.
New Orleans: Whitney Central Bldg
Philadelphia: Stephen Girard Bldg.
San Francisco: 32 Beale St.
Pittsburgh: Fidelity Bldg.
Los Angeles: Central Bldg.
Chicago: Monadnock Blk.
Seattle: L. C. Smith Bldg.
Portland: Yeon Bldg.

Selling agents in 16 other cities.

P&H EXCAVATOR-CRANE

volume of road materials to be delivered by railroad cars, some type of car should be designed that would permit of more rapid unloading by more economical methods. If this is not done, it is hoped at least that open-top car manufacturers will improve the design of their cars and make them so that they can be more easily unloaded with clam-shell equipment. Not only would such improvement aid the individual unloading the car, but the railroad company would add to the life of its equipment.

Many open-top cars are now designed with projecting angles, rivets, bolts, braces, timbers, etc., which interfere with the efficient operation of the clam shell. It is difficult to understand why railroad cars could not be designed so that the interior of the car would be perfectly smooth. In fact, it would be practicable and economical for all open-top cars to be built with a fillet having a radius of about 18 ins. in the bottom angle at the end of the car. The curved bottom angles would permit the cars to be emptied more rapidly and economically either with hand shovels or clam shells.

Further investigation should also be made of the use of open-top removable batch boxes for railroad transportation of materials. While the substitution of standardized batch boxes for open-top cars would be a very radical departure from present equipment, the average construction plant could be designed to handle the boxes much more economically than the loose materials.

The foregoing discussion is from a paper by Mr. Piepmeier before the Spring meeting of the American Society of Mechanical Engineers, May, 1921.

PLANNING AND ORGANIZING A ROAD CONSTRUCTION JOB

By C. D. Curtis, Assistant to Chief, U. S. Bureau of Highways, Washington, D. C.

While everyone will concede that all construction jobs should be carefully planned and well organized for the handling of materials, it must be admitted that this is not always done. In the past, too little thought and study have been given to this preliminary phase of the work. Until recently, however, road work has been handled on a comparatively small scale, and the cheaper types of construction prevailed. An extensive plant was not required and the evolution brought about by the general adoption of higher types of construction and the growth of construction programs is still under way. It is unfortunate, but nevertheless a fact, that most jobs are equipped without giving to their planning and organization a proper amount of careful study. As a result expected profits shrink and may even become actual losses.

Improperly Equipped Jobs

Improperly equipped jobs can be classified under three heads.

1. Too much plant.
2. Lack of plant, and
3. Unbalanced plant.

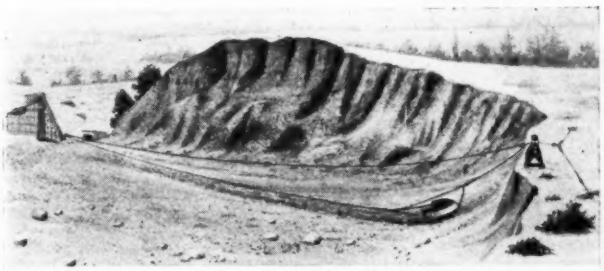
With too much plant on a job efficiency of operation is lowered, and although fairly satisfactory progress may be made the cost will be too high. Rental, or interest on investment and depreciation charges, continue regardless of output. On an underequipped job it is necesary to resort to labor which may be less efficient and more expensive. The progress of the work is likely to be delayed and total costs increased.

Of all the improperly equipped jobs the ones that have an unbalanced plant are probably most common. They are the inevitable result of equipping without planning. The several units making up the plant may be efficient mechanically, when considered alone but totally incapable of being worked smoothly and continuously together. On such jobs efficient operation cannot be secured. The plant investment might, and probably would, be higher than for a balanced plant. The season's profits, however, are certain to be lower than anticipated.

Road Jobs Classified

In my opinion a classification of road construction jobs based on the desirable and practicable rate of progress is feasible and would aid the contractor or engineer in selecting the proper plant. In determining on such a classification several factors would enter into the consideration, chief of which would be the size or length of the project. Another factor would be the problem of satisfactory detours and the probable economic loss to traffic.

The cost, of course, would be affected by the classification. Ordinarily a higher rate of progress would be required on a large job than on a small one. The extra cost then of assembling and operating a large plant capable of rapid progress would be spread over a large yardage. It might easily happen, however, that the economic conditions would warrant requiring very rapid progress on a comparatively small job. This would change



CONSERVATIVE claims for the smallest sizes of Sauerman Bottomless Power Scrapers, based on the statements of contractors and county road commissioners who are using them, are that a Sauerman Scraper operated by one man will displace from 6 to 15 teams and slip scrapers. The largest sizes of Sauerman Scrapers are considered by the commercial gravel producers who use them as being the equal of a small steam shovel with the added advantage that they will not only dig but also convey the sand and gravel to the plant.

The many advantages of this one-man-operated combined excavator and conveyor are explained in our Pamphlet No. 12, with illustrations and diagrams of actual installations. Write for this booklet today.

Sauerman Bros., 1142 Monadnock Bldg. Chicago

SAUERMAN SCRAPER SYSTEMS

Special Article Service

"If you don't see what you want, ask for it."

Thus the merchant to his customers; and thus, also, the editor to his readers.

Readers are invited to write the editor requesting that articles be published on subjects in which they are individually interested.

It is quite likely that each reader, while finding the magazine interesting as a whole, sometimes looks in vain for an article on some one subject of great and immediate interest to him. We can obtain and publish that article as easily as any other.

If is probable that articles so produced will be of value to others than the ones requesting their publication.

Tell us about it and we will do the rest.

Municipal and County Engineering
702 Wulsin Building INDIANAPOLIS, IND.

LITTLEFORD

PORTABLE
HEATING EQUIPMENT
FOR CONTRACTORS AND MUNICIPALITIES

Tar Heaters
Fire Wagons
Tool Heaters
Lead Furnaces
Mastic Heaters
Gravel Heaters
Patrol Heaters
Asphalt Heaters
Distributing Tanks
Also
Pouring Pots and Asphalt Paving Tools

LITTLEFORD BROS.
460 E. Pearl St. Cincinnati, O.

the classification and increase the cost of the work, but the bidder would know just what to expect.

Suggested Classification of Concrete Road Jobs

In connection with concrete road jobs there might be three classes such as,

(A) Jobs on which equipment with a daily capacity of 1,000 ft. of 18 ft. roadway would be required.

(B) Jobs on which equipment with a daily capacity of 500 ft. of 18 ft. roadway would be required, and

(C) Jobs on which equipment with a daily capacity of 250 ft. of 18 ft. roadway would be required.

In the case of Class A jobs it would ordinarily be desirable to equip with at least two complete operating units. This would insure continued even though retarded progress in the event of a breakdown of one unit.

Such operations would, of course, be contingent on the weather and other conditions beyond the contractor's control, but the classification would give a more definite idea of the requirements and enable the engineer and all bidders to estimate on the same basis. The classification conditions should be covered fully in the specifications.

Influence of Specifications on Construction Plant

Unnecessary refinements in specifications which are met at times, usually lead to difficulties in operation and should in my opinion be avoided, especially where their enforcement increases the cost of operation for minor or questionable benefits. At the present time there are but few arbitrary requirements in specifications directly affecting the selection of equipment. There are, however, certain limitations which make necessary an intimate knowledge of the specifications under which work is to be performed. Examples of these limitations are:

1. Time limit on depositing of concrete after mixing. This limit would have a direct bearing on the location of central mixing plants and the equipment required for handling both the aggregate and the concrete.

2. Definite requirements relative to concrete mixers such as water measuring devices, boom and bottom dumping bucket, etc. Such requirements are small details but must be met and so must be considered in selecting equipment.

3. Materials for concrete not allowed on subgrade. This feature is very important and makes necessary a careful study of the project in the field. Several alternate methods of handling the materials may be possible and the most economical and efficient one can only be determined after a consideration of all the conditions.

One location might be well adapted to the use of industrial railway equipment, while in another location this method might be entirely impracticable and hauling of proportioned batches of aggregate and cement in trucks the most feasible. The central mixing plant method might be the proper selection in some other location. In the case of a large job conditions may vary considerably on different sections of the same job.

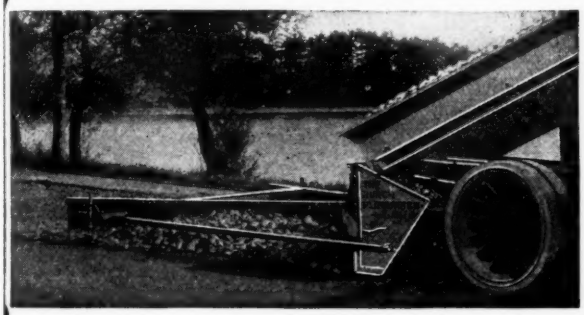
General Factors to Be Considered in Selecting Plant Units

In selecting equipment for a project, everything bearing on the situation should be considered. The source of materials to be used, whether local or imported, condition of roads to be hauled over, width of available right of way, trackage and storage facilities available at receiving points for materials requiring rail transportation, maximum grades, water supply, availability for common labor and teams, and length of working season are some of the factors which should be looked into and studied before deciding on the type of plant to be used.

In this connection the engineer may and should render all possible aid to the contractors. The preliminary investigations and detailed surveys made by the engineer give him much more information than the contractor can secure readily in his preliminary field inspection of the project. If the engineer knows that the conditions even though not apparent make the use of certain types of plant impracticable this information should be given to the contractor.

A feature which perhaps is not germane to this discussion, but which is very important and deserves a few words, is the desirability of considering the source of the materials to be used with respect to the possibility of continuous rail transportation service. Without a reasonable assurance of a continuous supply of materials throughout the working season an elaborate plant layout may become much more of a liability than an asset.

By arranging to ship and store materials, during the season of light demand for open top cars, for use during periods of car shortage a continuous supply of materials can be secured. Such an arrangement may considerably alter the selection of equipment for handling the material. Strong arguments may be made against the plan of advance storage of



One Operation—

One man and one operation dumps and spreads the stone for your road when you use a Burch Stone Spreader. Think of the time saved as well as the expense of hiring stone spreaders.

THE BURCH STONE SPREADER

A few days' operation pays for itself. The stone goes through the spreader only when the truck is moving, insuring an even depth and uniform width. All road requirements are provided for in adjustments which can be made in a few minutes. You ought to know more about this contractor's friend. Let us send you complete information.

THE BURCH PLOW WORKS CO.

Dept. G-7 Crestline, Ohio

WM. E. DEE CLAY MFG. CO.

Proprietors of MECCA CLAY WORKS

Manufacturers of

STANDARD AND DOUBLE STRENGTH

Sewer Pipe, Drain Tile, Culvert Pipe, Well Tubing, Flue Lining, Wall Coping and Fire Brick.

WORKS { Mecca, Parke County, Ind., on C. & E. I. R. R.
Newport, Vermillion County, Ind., on C. & E. I. R. R.

Chicago Office, 30 N. LaSalle Street.

THE CUMMER ROAD ASPHALT PLANT

THREE SIZES THREE UNITS

Capacity 750, 1250 and 1800 Square Yards 2-inch Top or Macadam Daily

THE CUMMER ONE-CAR ASPHALT PLANT

Capacity 2000 Square Yards 2-inch Top or Macadam Daily

THE F. D. CUMMER & SON COMPANY

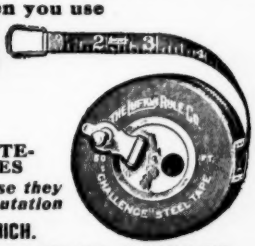
CLEVELAND, OHIO New York Office, 19 West 44th Street

Faultless Service in Every Respect

THAT'S WHAT YOU NEED WHEN TAKING MEASUREMENTS

That's what you can rest assured you are getting when you use

LUFKIN TAPES



PIONEERS IN CONNECTION WITH THE NOTE-WORTHY IMPROVEMENTS MADE IN TAPES

More of them are in use than all other makes because they have for years consistently maintained the highest reputation

Send for Catalog No. 26 **THE LUFKIN RULE CO.** SAGINAW, MICH.
NEW YORK. LONDON, ENG. WINDSOR, ONT.

materials in the states where estimates for materials delivered are now allowed, but the extra cost of storing materials may be more than offset by the gain due to continuous operation during the construction season.

It is desirable of course when possible, to avoid all unnecessary rehandling of materials. Where the materials can be unloaded from cars or loaded from the quarry or pit directly into containers for transportation to the job and in addition can be deposited in the mixer, in the case of concrete, without touching the ground, a great advantage is gained. In addition to being kept free from mixture with foreign matter, the item of waste is very greatly reduced.

Room for the Small Contractor

In some states, by adopting the practice of letting large contracts for long stretches of construction work, large contracting companies have been induced to enter the highway field. They have brought trained operating organizations to the work and have put extensive road building plants on their jobs. There is wisdom in such procedure whenever possible for, of necessity, a great many road jobs are and will continue, for a variety of reasons, to be of comparatively short length. Letting contracts in both large and small sections gives both the small and the large contractor a field of operation, and greatly expedites the carrying forward of a large program. The small contractor, acting as his own superintendent and operating with but little mechanical equipment, has but little overhead and can compete on a small job with the large contractor operating a large plant and carrying heavy overhead expenses.

Road building differs from most other construction activities in that the operations are conducted along an extended narrow path. The failure of one link may interrupt the work of a whole operating chain. This fact makes the present tendency toward the development of large individual units somewhat questionable in my opinion. When a large unit is used every precaution should be taken to insure its continuous operation.

Holding an Organization Together

One of the greatest handicaps which the road builder encounters in the northern states is the short construction season. Continuous operation is impossible and each season it is necessary to organize new construction forces. It takes some little time to organize a new outfit so that the work will proceed satisfactorily. In the case of the skilled mechanics and firemen an attempt should be made to retain their services the year around. They can be utilized during the winter in repairing equipment and putting it in first class condition for the next season's work. It may even be necessary to furlough them for a time with pay but the investment will bring big returns in added loyalty to the company and increased devotion to duty. The average man appreciates a square deal and will show it in increased efficiency. The use of an extensive plant requires skilled operators and, once trained, their services should be retained. Efficiency of operation in road work depends on the proper functioning of all the separate units. The mechanical units function properly only when properly handled.

On large jobs where more than one plant or complete operating unit is used, the spirit of the organization can be kept up by introducing friendly competition. The rivalry between two outfits to reduce costs and increase yardage has a very healthful effect on progress and incidentally on profits. I recall a bituminous concrete construction project on which four separate mixing plants were used. One of the plants was an old, makeshift affair but was handled by an energetic superintendent who had old and loyal employes of the company as foremen and mechanics. The output and costs compared more than favorably with the new plants, due entirely to the better morale of the men. It pays to retain loyal and efficient employes.

The foregoing is the major portion of a paper presented by Mr. Curtis at the spring meeting of the American Society of Mechanical Engineers, May, 1921.

OBITUARIES

Mr. Thomas L. Smith, founder, director and chief stockholder of the T. L. Smith Company, died Friday, April 29, 1921, at his home in Milwaukee.

Although Mr. Smith brought out a number of successful inventions during his life, he is probably best known as the inventor and manufacturer of the line of Smith tilting mixers. Because of his activities in designing and producing mixers, pavers, excavators, crushers, etc., his career has a unique significance in the field of construction and engineering.

Born in England, June 6, 1855, he came to this country with his parents at the age of four, received his early schooling

at St. James Episcopal Parochial School, Milwaukee, and while still a boy, moved to Watertown, Wis., where his father had established a machine shop and foundry. In his father's shop he learned the machinist trade.

In 1873 he entered Iowa State College at Ames, Iowa. Although he had no high school education, he graduated in 1877 with the highest marks ever awarded an Ames student up to that time, including fifteen perfect grades for full terms. It

T. L. SMITH

was apparent that he was a "natural born engineer." During his four years at Ames he acted as instructor in the college machine shop, thus paying his own way and contributing to the support of his parents at home, as well.

After his graduation, at the age of 22, he was appointed instructor of the college in mathematics and bookkeeping. After several years in that capacity he went to Boston, where he completed his engineering education in the Massachusetts Institute of Technology.

In 1920, Iowa State College conferred upon him the Honorary Degree of Doctor of Engineering, in recognition of his accomplishments.

The early part of his career, immediately following his college life, was spent in drafting and engineering work with some of Milwaukee's large manufacturers, including Allis-Chalmers Co., Filer & Stowell Mfg. Co., Pawling & Harnischfeger Co., C. J. Smith & Sons Co., and Kempsmith Mfg. Co. D. J. Murray Mfg. Co., Wausau, Wis., manufacturers of logging machinery, also employed him as chief engineer. During this period he invented the first really successful woodcarving machine.

His interest in concrete mixers developed in 1898 and '99, when he was conducting a school of engineering and mechanical drawing in Milwaukee. Mr. D. W. Cutter, a large contractor, had impressed him with the need for a successful mixer. No thoroughly practical machine was known at that time. In 1899 Mr. Smith's invention of the Smith tilting mixer took definite form and the first machine was manufactured in 1900. It was a complete success from the very beginning. This first mixer gave ten years of hard service.

That machine was the beginning of his success as a manufacturer. He took out patents and built additional machines. With assets of only $500 in 1900, the business grew so rapidly that in 1905 he organized a corporation known as the T. L. Smith Company, which today has assets of over $1,200,000.

The T. L. Smith Company represents only one of his successful business ventures. When the Sterling Wheelbarrow Company, West Allis, Wis., was a small struggling concern on the verge of bankruptcy, Mr. Smith purchased a controlling interest and within a few years developed that business to the point where it was the largest and most successful of all his holdings at the time of his death.

The Smith Engineering Works, Milwaukee, manufacturers of Telsmith Rock and Ore Crushers, is another company organized and developed to a high degree of success by the inventive genius and business ability of T. L. Smith.

His career was successful not only from a business standpoint but also from that higher standpoint of personal success. He never for one moment permitted his business success to interfere with his love and sense of duty for home, family and community. His rise in civic, Masonic and religious affairs kept pace with his business achievements. All worthy charity endeavors found him a cheerful and willing contributor. He loved music, art and literature and these were always his chief sources of pleasure and recreation. His purest treasure was his spotless reputation.

Samuel Theodore Morse, city engineer of Carlinville, Illinois, and former county surveyor, was instantly killed on June 3 when his automobile was struck by a Chicago and Alton passenger train at Rainey crossing, three miles south of Carlinville. He was driving from Carlinville to Macoupin Lake on business and was alone

in the car when the accident happened. As the crossing is a fairly good one, friends are unable to understand how the accident occurred. Mr. Morse, who was 49 years old, is survived by a wife and ten children. He was a contributor to engineering journals and to the proceedings of engineering societies. He was a graduate of the University of Illinois and was very influential and prominent in Macoupin County.

GRADING BOTH SIDES OF ROAD AT ONCE

Grading both sides of a road at once is the newest thing in maintenance. Blade graders have been pulled singly and in tandem behind tractors, but to pull two abreast is quite a new idea. The illustration shows the outfit of Commissioner Moore of Janesville, Wisconsin, at work on the Milton-Johnstown center road in Wisconsin. The equipment consists of a 10-ton "caterpillar" tractor pulling two 8-ft. Quick Lift Graders, grading an average of 30 miles of road per 10-hour day.

"CATERPILLAR" TRACTOR PULLING TWO ROAD GRADERS ABREAST.

A small drag can be added to the tail end to smooth off the crown after the graders have passed, leaving a smooth even surface from shoulder to shoulder. The cable is used as a tow-line in crossing bridges too narrow to take both graders abreast.

UNIQUE EXPORTING

On March 19th the Austin Machinery Corporation of Chicago received an urgent Mexican shipment order from the New England Fuel Company. This called for an Austin Model 6-T crane rigged for clamshell bucket operation.

This machine was loaded at Toledo immediately and on arrival at ship's side at Port Arthur, was met by a big tanker, awaiting the crane's arrival, with steam up. A little gasoline and oil were put into the engine,—it was cranked up once,—the engine turned over, and the machine walked off the freight car under its own power, across the dock, across two 12 by 12 in. timbers laid between the dock and the boat, crawling directly onto the deck of the tanker, which was all ready to put to sea. The tanker's derrick picked up the boom of the crane from the flat car, set it on the deck, and the machine and boom were lashed down on the deck the same afternoon and the tanker immediately got under way. The run to Tampico was made in a few days, the lashings were cast off, and again the machine walked off the deck of the tanker under its own power onto the private dock of the oil company. The tanker's derrick again picked up the boom, loaded it on the dock, the boom was fitted to the crane and it immediately walked to its working location and started doing its job just 26 days from the day order was placed.

The Austin Machinery Corporation believe this is a record in delivery of a machine from factory to working operation in the export field, and this crane has been on the job giving overtime service every day since.

Contracts Awarded

ROADS AND STREETS

Cal., Susanville—Warren Constr. Co. awarded contract for paving Main street, at $131,580.

Cal., Ventura—Southwest Paving Co., 415 Washington Bldg., Los Angeles, awarded contract for paving Poli and other city streets (about 50 blocks), at $172,122.

Ia., Clinton—McCarthy Impvt. Co., Davenport, awarded contract for improvement of Bluff Rd. and Harrison Rd. by grading and paving, at $90,000.

Ia., Ft. Madison—Cameron, Joyce & Co., Keokuk, awarded contract for grading, draining and surfacing 8.51 miles Primary Rd. 60, involving 67,888 cu. yds. excav., 89,663 sq. yds. bitum., 4,800 ft. 6-12 in. tile pipe, at about $176,000.

Kans., Girard—Independent Constr. Co., Pittsburg, Kans., awarded contract for grading, paving and draining 4.267 miles Commercial Hwy., F. A. P. 40 D. H. & I., at $179,261.

Kans., Leavenworth—Missouri Valley Bridge & Iron Co. awarded contract to lay something over 4 miles concrete slab on Fort-to-Fort Hwy., at $143,-058.

Ill., Hardin—John R. Scott, St. Louis, awarded contract for 75 miles earth, gravel or rock road. Money available for project, $200,000.

Ill., Springfield—Wilson A. Jaicks, 232 Pearson street, Chicago, awarded contract for 4.55 miles concrete paving in Will Co., at $103,218; Federal Paving Co., 133 W. Washington street, Chicago, awarded contract for 6.45 miles concrete paving in Kankakee Co., at $143,925. Contracts for grading as follows: 7.86 miles McLean Co., at $30,188; 7.84 miles at $23,326; 3.11 miles Wayne, at $21,956, to Cameron, Joyce & Co., Keokuk, Ia.; 2.58 miles in Clinton and Washington Counties to C. R. Cummins Co., Swetland Bldg., Cleveland, at $67,284; 1.70 miles Wayne Co., to Mautz & Oren, Effingham, Ill., at $6,962; 5.80 miles, Adams Co., at $17,-677; 5.70 miles, Adams Co., at $17,677; 5.70 miles, Adams Co., at $15,434, and 4.41 miles, Adams and Brown Counties, at $19,386, to A. O. McCoy, Perry, Ill.

Mass., Boston—Contracts awarded as follows: Road work in Andover to J. H. Fannon, Somerville, Mass., at $14,980; in Dracut, to Hanscom Construction Co., Boston, at $16,955; in Leicester, to C. E. Horne, Millbury, Mass., at $61,058; Mendon-Uxbridge, to J. H. Fannon, at $109,088.

Mass., Boston—State Hwy. Dept. let contract for paving 3,100 ft. state hwy. in Dracut, bitum. macadam, to Hanscom Construction Co., 70 Kilby street, Boston, at $16,955; 4.378 ft. in Leicester, rein. conc., to C. E. Horne, N. Main street, Millbury, at $61,059; 16,000 ft. in Mendon and Uxbridge, involving 10,372 ft. bitum. macadam and 5,628 ft. conc.; also 3,235 ft. in Andover, bitum. mac., to J. H. Fannon, 28 Hinckley street, Somerville, at $109,088 and $14,980, respectively; J. J. Lane, 347 Washington street, awarded contract by city for paving Chestnut Hill avenue and Beacon street, asph. conc., at $64,075; J. Kelly Co., 5 Ulmer street, awarded contract for paving Columbus avenue, involving 7,300 sq. yds. granite blocks on concrete base, at $50,894.

Mich., Houghton—Following contracts let for rd. work: Rd. 26-1A and 26-1B, Adams Twp., to Houghton Co. Rd. Comn., Houghton, at $70,976 and $44,182; Rd. 26-I, to Smith Holmes, Burridge, Sparks Co., Houghton, at $103,662.

Mich., Ishpeming—Board of Rd. Commrs. Marquette Co. awarded contract to improve 10 miles rd. in Forsyth and Turon Twps., at $221,250.

Mich., Lansing—Contracts for hwy. construction awarded as follows: Rd. 26-10, Houghton Co., .882 miles, to Houghton County Rd. Comm., at $42,000; Rd. 35-8-A.B., Marquette Co., 10.341 mi., to Houghton Co. Rd. Comm., at $221,250; Rd. 26-11, Ontonagon Co., 2,513 mi., to McDonnell & McFarlane, Duluth, at $100,430; Rd. 45-B2, Ingham Co., 0.203 mi., to Ingham Co. Rd. Comm., Mason, at $7,129.

Mich., Marquette—Houghton Co. Rd. Commr. awarded contract for building road in Forsyth-Turin Twps., E-Mac, Bas 15 ft. wide, 10.341 mi. long, at $221,250.

Mich., Ontonagon—McDonnell & McFarlane, Duluth, awarded contract for building road in Rockland Twp., B-grav., 16 ft. wide, 2.513 mi. long, at $100,430.

Minn., Chisholm—Aaby & Naturi, local, awarded contract for conc. paving on 7¼ miles Miller Trunk Rd. south of Eveleth, at $262,047.

Minn., Duluth—E. Johnson & Sons, Superior, awarded contract for subgrading 11 miles Miller Trunk Rd., 24 ft. wide, at $120,538.

Minn., Minneapolis—John McKusick, Hibbing, awarded contract for hard-surfacing Minn. Trunk Hwy. No. 10, Kandiyohi Co. proj., at $28,306 a mile —total of 11 miles.

Minn., Minneapolis—General Contracting Co.

FOR SALE OR RENT

One 10-ton "Peerless" Steam Road Roller; first-class condition; used on six miles road work. Address

M. F. Normoyle & Sons,
Box 221 Roanoke, Va.

KOLESCH SURVEYING INSTRUMENTS FOR SERVICE

"KOLESCH" Transits and Levels are unrivalled for long life and extreme accuracy.

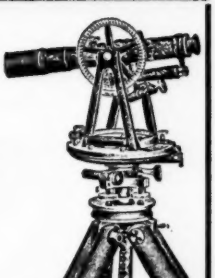
A Complete Service for Engineers

We carry a complete stock of all materials and instruments required for drafting rooms, engineering offices, surveying parties, etc. Our business has been developed by prompt attention and fair treatment to customers.

Send for Illustrated Catalog

KOLESCH & COMPANY

138 Fulton Street New York City



The Popular Kolesch 'PIONEER" TRANSIT No. 7710

awarded contract by Hennepin Co. Board to pave with Bitulithic, 10 miles Lyndale avenue, at $452,-759.

Minn., Minneapolis—Johnson, Drake & Piper, Minneapolis, awarded contract for asph.-concrete pavement at $215,902 on Superior boulevard.

Minn., Willmar—J. McKusick, Hibbing, awarded contract for paving 6 miles F. A. P. 31, at $28,306 per mile.

Miss., Jackson—S. A. Gano, Jackson, awarded contract for construction of 6 miles hard surface hwy., at $157,661.

Miss., Pontotoc—Lawrence, Nixon & Phillips awarded contract for conc. hwy. and conc. brdgs. Pontotoc Co., at $375,000.

Mo., Albany—Maloney & Whalen, St. Louis, Mo., awarded contract for grading, constructing culverts and bridges and gravel pavement on 6.26 mi. state road from Albany, at $101,162.

Mo., Union—J. P. Sparks, Washington, Mo., awarded contract for grading and constructing culverts on 2.38 miles Villa Ridge Cut-off, State Aid Proj. S. 20.61, Franklin Co., at $10,322.41.

N. H., Concord—State Hwy. Dept. let following contracts for road work: Paving 3.1 mi. state hwy. B, Contr. 43, Proj. 27, Windham, involving 5,600 cu. yds. earth excav., 32,664 sq. yds. bitum. macadam, to J. Arborio, 80 Church street, New Haven, at $65,394; 5.54 mi. hwy. B, Contr. 2, Proj. 27, Windham, 9,500 cu. yds. earth excav., 58,570 sq. yds. bitum. mac., to A. D. Bridges Sons, Inc., Hazardsville, Ct., at $123,785; 6.44 mi. hwy. H, Proj. 21, Skowhegan, 26,300 cu. yds. earth excav., 68,000 sq. yds. 6-in. bitum. macadam, to Ford & Smiley, Skowhegan, $211,145; 6 mi. hwy. N, Proj. 36, Calais, 15,300 cu. yds. earth excav., 63,387 sq. yds. bitum. macadam, to J. McCormick, 319 Taunton avenue, E. Providence, at $185,604; 2.19 mi. gravel road, Monticello, to McCabe & Giovanni, E. Boston, Mass., at about $41,000; 7.08 mi. conc. rd., Gray, to Bruno & Pettiti, 18 Tremont street, at $322.000; Winslow & Cummings, Nashua, awarded contract for paving 1.2 mi. hwy. Merrimack, 0.94 mi. bitum. macadam rd., Bethlehem, at $11,968 and $17,977, respectively; Marshfield Constr. Co., Marshfield, awarded contract for paving 2.5 mi. at $107,351; S. B. Van Wagenon, Inc., Rondout, N. Y., 0.32 mi. Ulster Co., at $43,797; Robt. Wemple, Fultonville, low bidder for repair of roads Fulton and Montgomery counties, at $22,508; Spellman-Oliver Co., Chateaugay, N. Y., contract for 8.07 mi. St. Lawrence Co., at $108,780.

N. Y., Albany—C. T. Hookway, Syracuse, awarded contract for constr. of cement conc. pavement 16 ft. wide, with necessary excav., draing., etc., on Hwy. 8020, Broome Co., at $179,590.

N. Y., New York—Central Park sheet asph. on conc. foundation (paving carriage roads) let to Asphalt Constr. Co., 308 Broadway, at $135,792; W. J. Fitzgerald, 547 W. 45th street, awarded contract for regulating and repaving 11th street—Broadway to Seventh avenue—sheet asph., at $58,-415.

N. Y., Schenectady—Wm. P. McDonald Constr. Co., New York City, awarded contract for resurfacing several streets and repaving Broadway, at $109,434. All resurfacing will be with asphalt; new pavement on Broadway, asph. with concrete base.

N. C., Asheville—State Hwy. Comn. Div. Office here let contract for grading, draining and surfacing 7.56 mi. rd. from Balsam to Sylva, F. A. P. 70-B, Jackson Co., at $111,360.

N. C., Bakersville—C. C. McCabe, Tuxedo, awarded contract for grading, draining and surfacing 3.67 mi. rd. betw. Bakersville and Toecane, at about $200,000.

N. C., Durham—Elliott, Sholes, Teer Co., Durham, awarded contract for building 4.1 miles F. A. P. 110, Orange Co., at $174,550.

N. C., Leaksville—Carolina Constr. Co., Leaksville, awarded contract for paving various streets, involving 40,000 sq. yds. 1¼x1½ in. asph. on 5-in. conc. base, at about $128,000.

N. C., Winston-Salem—Royer, Ferguson Co., Silver Springs, Md., awarded contract for hard surfacing 10.57 mi. street highway—High Point to Winston-Salem—at about $386,000.

O., Columbus—Contracts let as follows by State Hwy. Commr.: Brandt pike, 4.617 miles, plain conc., to A. W. Smith, Dayton, at $149,819; Greenville pike, 5.13 miles conc., to D. A. Onbst, Dayton, at $199,857; Germantown pike, 2.969 miles plain conc., to William & Little, Cleveland, at $91,514.

O., Hamilton—Andrews Asphalt Paving Co. awarded contract for paving Mt. Pleasant Pike, at about $200,000.

Okla., Durant—Healy Constr. Co., Muskogee and Dallas, Tex., for 35 mi. gravel road and bridges, F. A. P. 41, at $546,441.

Okla., Okla. City—Healy Constr. Co., Muskogee, awarded contract for impvt. of F. A. P. 41, Bryan Co.—35 miles gravel road—at $540,441; constr. of 7 bridges on this road awarded to General Constr. Co., St. Louis, Mo., at $81,756; Gibson & Mitchell, Pauls Valley, Okla., awarded contract for F. A. P. 20, Kay Co.—5 miles conc. road—at $200,000.

Pa., Harrisburg—State Hwy. Dept. Harrisburg let contracts for building Route 281, Bucks Co., to J. Jianjola, 41 Princeton avenue, Trenton, N. J., at $51,351; Route 156, Bucks Co., to Cranford Paving Co., 2620 East street, N. W., Washington, D. C., at $935,917; Route 313, Clearfield Co., to G. E. Kelly, 189 Montague street, Brooklyn, N. Y., at $308,131; Route 58, Clinton Co., to Standard Contg. Co., Altoona Tr. Bldg., Altoona, at $64,560; Route 82, Crawford Co., to Smith Constr. Co., 707 Wick Bldg., Youngstown, O., at $346,063; Application 1252, Cumberland Co., to Winston & Co., Hughesville, at $168,141; Route 225, Delaware Co., to V. DiFrancesco, Llanerch (Phila., P. O.), at $106,-707; Route 280, Fayette Co., to Conmar Constr. Co., Fayette City, at $162,032; Route 366, Fayette Co., to A. Barber, 180 Henry street, Binghamton, N. Y., at $228,590; Route 55, Tyrone Twp., Blair Co., Spruce Creek and Morris Twps., Huntingdon Co., to J. L. Elder, Ebensburg, at $168,136.

Pa., Philadelphia—Contracts for $112,000 worth of paving work let by Mayor: Surfacing Oregon avenue, 7th to 13th streets, to Barber Asph. Paving Co., at $68,500. This avenue is 120 ft. wide; also contracts for paving 57th street, Florence to Warrington avenue, at $7,800; Louden street, 9th to 10th, $6,150; Stewart street, 57th to 59th streets, and from 57th, Stewart to Haddington street, at $10,100; Fisher avenue, 6th to 9th, at $20,000; Fish-Rutherford, Inc., contract for rebuilding northwest end Broad street and Lehigh avenue, at $70,000.

Tenn., Dyersburg—Rocks & Eller awarded contract for construction of 8.2 miles Jeff Davis hwy. connecting Dyersburg and Newbern; 6-in. conc. base, asph. conc. top, $280,000 available.

Tenn., Nashville—A. F. Rearden, Sparta, awarded contract by State Hwy. Dept. for constr. of 9.91 mi. St. Hwy. No. 16, bet. Holston River and Mtn. City, Johnson and Sullivan counties, at $137,767; Rhodes & Eller, 310 Commercial Club Bldg., Nashville, awarded contract for constructing 8.28 miles St. Hwy. 12, between Dyersburg and Newbern, Dyer Co., F. A. P. No. 52, at $288,513; Foster & Creighton Co., Nashville, awarded contract for constructing 9.94 miles St. Hwy. No. 3 between Cheatham Co. line and Burns, Dickson Co., F. A. P. 46-B, at $128,420.

Tex., Boston—Smith Bros., Crockett, awarded contract for clearing, grading and draining 12.3 miles State Hwy. 1, Maud Red Water Rd., and 4.05 mi. St. Hwy. 8, Maud south to Sulphur River, at $125,550 and $33,324, respectively.

Tex., Sierra Blanca—H. E. Williams, El Paso, Tex., awarded contract for constructing 24.81 miles St. Hwy. No. 1, at $128,314.

WATER SUPPLY AND PURIFICATION

Ariz., Phoenix—Western Pipe and Steel Co., Phoenix, awarded contract for furnishing 6,000 ft. 30-in. steel pipe to be used for completion of Verde water system, and to enlarge certain main, at $32,940.

B. C., Courtenay—E. J. Ryan Contg. Co., Ltd., 445 Granville street, Vancouver, awarded contract for building gravity water supply works system, involving 2 miles 8-in., 2½ mi. 10 and 12-in. and 1½ mi. 6-in. wood pipe, at $73,700.

Ont., Courtright—Town let contract for furnishing and laying 10,500 lin. ft. 4 and 6-in. c. i. pipe with specials, valves, hydrants, etc., to Webster Constr. Co., Bank of Toronto Bldg., London, at about $30,000.

Ont., Scarboro—Twp. let contract for building filtr. plant to Central Foundation Co., 14 Wellington street, East Toronto, at $67,000; centrif. pump, to Canadian Allis-Chalmers, 212 King street, W., Toronto; triplicate pumps to Goldie & McCulloch, Traders Bank Bldg., Toronto; chlorine control service to General Supply Co., 38 Toronto street, Toronto.

Ont., York—Twp. let contracts for laying water mains in Dawes Road, Sammon and Chisholm streets, Woodbine, Roseyear and Donald avenues, to McKnight Constr. Co., 88 St. David street, Toronto, at $20,000; Leslie street to W. Fraser, 374 Jones avenue, Toronto, at $6,397; Sammon, Bee and Cronyn streets to G. Thompson, 40 Jarvis street, Toronto, $16,885; Weston Road, Eglington, Martson and Cayuga avenues, to J. G. Jack, care F. Barber, Engr., 40 Jarvis street, Toronto, at $4,000; Olympus & Harcourt avenues to Murphy Contg. Co., 8 Wychwood Pk.. Toronto, $2,000; Keele and Regent streets, Mason, First, Alameda, Glenholem and Mayfair avenues and Florence Crescent, to W. B. Mitchell, 110 Heath street, Toronto, at $5,000.

Fla., St. Petersburg—City will expend $118,000 to improve water works. Layne & Bowler, 37 N. Van Buren street, Chicago, Ill., and Fairbanks, Morse & Co., 900 S. Wabash avenue, Chicago, Ill., have contracts to install 4 centrif. pump units. 1,000 G. P. M. capy. each, against total head of 50 lbs. per sq. in. direct connected to 50-hp. induction motor; 2 air compressors, each 1,200 cu. ft. air per in. capy.; centrif. pump with 1,500 gals. capy. per min.; direct connected with gasoline engine; air compressor with capy. of 600 cu. ft. per min., etc.

Ia., Everly—Smith & Wendt, Spencer, awarded contract for building water works and sewage disposal plant, at about $65,000.

La., Haynesville—Home Construction Co., 1507 Walnut street, Kansas City, Mo., and Lexington, Ky., awarded contract to construct 75,000-gal. elevated water tower, rein. conc. ground storage reservoir, water supply air lift equipt., fire pumps, etc., at $50,000.

Mich., Detroit—Booth & Flynn, 17 Battery Pl., N. Y. City, awarded contract for building tunnel 2,300 ft. long, brick-lined to contain 48-in. main, under Mt. Elliott and Elmwood Cemeteries, at $273,700; W. H. Mueller, 1711 Ford Bldg., awarded contract for building superstruct. of low-lift pumping sta., 1 sty., rein. conc. brk. and steel in Water Wks. Park, at $120,750.

Minn., Duluth—Worthington Pump & Machy. Co., 115 Broadway, N. Y. C., awarded contract for furnishing pump for Lakewood Pumping Sta., at $39,595.

Neb., Atkinson—Following contracts let for pump house: Pump house to Weller & Hise, Atkinson; pump to Keystone Deep Well & Pump Co., Beaver Falls, Pa.; well and standpipe to Kelley Well Co., Omaha, Neb., at $30,000.

N. C., Proximity—Tucker & Laxton, Realty Bldg., Charlotte, awarded contract for installing filtr. plant (20,000,000-gal. capy.), at about $150,000.

O., Cleveland—Hunkin-Conkey Constr. Co., 601 Century Bldg., awarded contract for building Baldwin Reservoir, 125,000,000 gal. capy., conc., at $2,052,241.

Pa., Philadelphia—A. A. Pastore, Philadelphia, awarded contract for building 6, 10 and 12-inch water mains, at $34,210.

Pa., Philadelphia—J. Jos. McHugh awarded contract for 60-in. steel pump main from Queen Lane pumping station to the filter beds, at $270,790; Anthony Pastore, contract for laying 6, 8, 10 and 12-in. cast iron water pipe, at $34.210, to be supplied by the U. S. Cast Iron Pipe & Foundry Co., at $44,996; Philadelphia Stack & Tank Works, Inc., contract for delivering steel plates and angles for Queen Lane Station, at $3,352, and U. S. Cast Iron Pipe & Foundry Co. contract for delivering flanged specials, at $5,687; McArdle & Co., 519 Arch street, awarded contract for furnishing pipe and fittings, at $1,400; J. Joseph McHugh, 1430 S. Penn square, contract for furnishing and laying 36-in. riveted steel pipe on Front street between Cayuga and Hunting Park avenue, at $24,000.

Tenn., Martin City—Chuse Engine & Mfg. Co., Mattoon, Ill., awarded contract for impvt. of water works, at $100,000.

Tex., Ft. Sam Houston (P. O. San Antonio)—Elder Constr. Co., San Antonio awarded contract to construct water mains in Kelly Field, at $60,229.

Va., Norfolk—Sanford & Brooks Co., Water and Commerce streets, Baltimore, Md., awarded contract to construct 12,000,000-gal. filtr. plant and pumping station, at $267,447.

Va., Norfolk—Lynchburg Foundry Co., Lynchburg, Va., awarded contract for flexible iron pipe for supply line from Lake Prince reservoir to city, at $129,091.

Wis., Sauk City—Village let following contracts for building water works system: Laying water mains, etc., to A. A. Luebke, Watertown, at $11,218; hydrants, to R. D. Wood & Co., Philadelphia, Pa., at $2,981; valves, to Ludlow Valve Co., Troy, at $916; pipe, to A merican C. I. Pipe Co., 38 So. Dearborn street, Chicago, at $23,391.

SEWERAGE AND SEWAGE TREATMENT

Cal., Los Angeles—Adam Dalmatin and Mike Guho, 818 E. 40th street, awarded contract to construct cement pipe sewer in Indiana street, at $62,054.

Cal., Merced—California Pottery Co., Merced, will furnish about 32 carloads vit. pipe for sewage disp. sys., to be built in Yosemite Valley; Schulz Constr. Co., 46 Kearny street, San Francisco, awarded contract for constructing the disposal system, including 2 pumping plants for Yosemite Valley, at $105,595.

Que., Montreal—Dillon & O'Sullivan, 2416 Christope Columbe street, awarded contract for sewer in Darlington street, at $24,232.

Fla., Miami—J. J. Quinn Co. awarded contract to construct 8½ miles 8 to 24-in. terra cotta pipe san. sewers, at $109,807; C. H. Lynn Foundry & Mach. Co. awarded contract for castings.

Ind., Indianapolis—Sheehan Constr. Co., 209 Holliday, city, awarded contract for 56th and Westfield road drain, at $283,370.

Ia., Arlington—Dearborn Constr. Co., 2nd floor Waterloo Savings Bldg., Waterloo, awarded contract for building 12,000 ft. 8-12 in. vitr. clay pipe sewers in various streets, at $21,466; Imhoff tank, sludge bed, filter and filter house, to Ward & Weighton, 516 Davidson Bldg., Sioux City, at $12,899.

Ia., Hampton—A. Phelps & Sons, Knoxville, awarded contract for building sewerage system, sewage treat. plant, outlet sewers and Imhoff settling tank, etc., involving 5,386 ft. 8-15 in. salt glazed vit. pipe, 12 manholes and 48 ft. 8-in. c. i. pipe, at $63,077.

Ia., Pleasantville—Ward & Weighton, 516 Davidson Bldg., Sioux City, awarded contract for building sewage disp. plant and san. sewerage sys., involving 21,305 ft. 8-in., 2,720 ft. 10-in. and 1,475 ft. 12-in. vitr. sewer pipe, 432 ft. 6x8x4 in. joints, 36 6x10 in. joints and 40 manholes, at $77.890. G. G. Herrick, Des Moines, awarded contract for building sewerage system, at $42,741.

Ia., Sheldon—A. Amundson, Roland, awarded contract for complete san-sewer and septic tank at $37,125; W. Carter, Sioux City, awarded contract for disposal plant at $18,300. Impvts. are to be made in Lake Park.

Me., Rumford—J. H. Kerr, Rumford, awarded contract for constructing 4,200 ft. new sewers, involving 3,840 ft. 10-15 in. vitr. pipe, at $35,900.

Mich., Detroit—City let contracts for building Sec. 3, Bates street sewer, to Brandon and Hanna, 1624 Dime Bank Bldg., $583,402; Sec. 7, Seven Mile Rd. sewer to Jeynes & Affeld, 1208 Ford Bldg., $219,876; Sec. 2, Bauman avenue, Arm sewer, and Sec. 5, Newport avenue sewer, to W. Blanck & Co., 827 Ford Bldg., at $49,790 and $58,586, respectively; Erwin avenue sewer to Detroit Draing. Constr. Co., Penobscot Bldg., at $16,770; Lat. 3,384 to Oakwood Constr. Co., 165 Fort boulevard, at $18,500.

Mich., Detroit—City let contracts for building lat. sewers as follows: (1) 3308, (2) 3401, (3) 3411, (4) 3446, (5) 3412, (6) 3413, (7) 3435, (8) 3439, (9) 3440, (10) 3442, (11) 3444, to Coleman & Harding, 702 Kresge Bldg. (1), $3,350; Western Constr. Co., 1208 Ford Bldg. (2), $28,371; (3), $21,651; (4), $11,617; C. R. Lennane, Union Tr. Bldg. (5), $23,005; (6), $21,795; Detroit Draing. Constr. Co., Ford Bldg. (7), $90,000; (8), $5,569; S. A. Duponovitch, Detroit (9), $8,365; G. R. Cooke, 1260 Penobscot Bldg. (10), $21,213; Langley & Barton, Penobscot Bldg., (11), $1,899.

Mich., Detroit—City let contracts for building lat. sewers as follows: (1) 3384, (2) 3460, (3) 3464, (4) 3391, (5) 3392, (6) 3429, (7) 3432, (8) 3433, (9) 3414, (10) 3452, (11) 3450, to Oakwood Constr. Co., 165 Fort boulevard (1), $18,500; (2), $3,474; (3), $3,252; Langley & Barton, Penobscot Bldg. (4), $18,897; (5), $15,326; R. D. Baker, 1631 Elmhurst (6), $5,865; (7) $6,127; (8), $8,077; J. Zaccola, Detroit (9), $2,100; (10), $3,000; Western Constr. Co., 1208 Ford Bldg. (11), $1,743.

Mich., Lansing—C. A. Handyside Constr. Co., 1656 Penobscot Bldg., Detroit, awarded contract for building Trunk Sewer Dist. 47, involving 3,468 ft. 84-in. rein. conc. pipe (conc. poured in place), at $118,812.

Mich., Pontiac—O. Halpin & Watts, Toledo, O., awarded contract for building 2,000 ft. 33-in. brick and conc. san. sewer in Bagley street, at about $60,000.

Minn., Stillwater—McGee, Nolan & Brothorton awarded contract to construct Mulberry street outlet sewer, at $62,699.

Mo., St. Joseph—J. H. Hartman, St. Joseph, awarded contract for laying new sewer pipe in alley west of King Hill avenue, from point northeast of center lines Texas avenue, at about $40,000.

N. J., Egg Harbor—J. M. Kelly Contg. Co., 507 Federal street, Camden, awarded contract for building 10 miles sewers in all streets, at $91,000; disp. plant to P. A. Hennesy, Paulsboro, at $34,134.

N. J., Linden—Joseph Meile & Co. awarded contracts for trunk sewer to be built in Linden Twp. and Roselle Boro, at $61,847.

N. Y., St. George, S. I.—J. Johnson Sons, West New Brighton, awarded contract for building san. sewers, etc., in Midland avenue, 10th street to Hinchcliff avenue, etc., at $81,378.

N. C., Burlington—Hedrick Constr. Co., High Point, awarded contract for constr. of sewers in various streets, at about $50,000.

O., Canton—Contract for building brick storm sewer in 18th street, N. W., let to Burd Constr. Co., 1043 Spring avenue, N. E., at $78,383; Sec. 2, east side, intercepting sewer from 3-way manhole to main trunk sewer, to Kimball Rd., S. E., and from Allen avenue, S. E., to e. branch of Nimshillen Creek, involving 3,460 ft. 42-in. segmental blk. pipe, to Garraux Bros., Canton, at $45,595.

Utah, Ogden—Security Bridge Co., Billings, awarded contract for construction of new outfall sewer system, at $351,010.

Va., Roanoke—Reed & Lapsley awarded contract for trenching and laying vitr. san. sewers in business section, at $162,013.

Wyo., Cheyenne—C. R. Inman, Casper, awarded contr. for trenching and laying vitr. san. sewers in business section at $162,013.

Prospective Work

ROADS AND STREETS

Ala., Camden—State Hwy. Dept., Montgomery, plans to constr. 12½ miles gravel road between Dixon Creek and Kimbrough, Wilcox and Marengo counties, $147,952; also road from Hartselle, 10½ miles, to Cullman county line, Morgan County; bitum. mac. on crushed stone or slag base, $261,500; also 16.7 miles road from Lafayette to Randolph county line, Chambers Co., at $77,412.

Ala., Chatom—State Hwy. Dept., Montgomery, plans constructing 13 miles of road from Axis to Mobile line, $177,250.

Ala., Monroeville—State Hwy. Dept., Montgomery, plans constructing 20.6 miles road in Monroe county, gravel, $104,798.

Ala., Talladega—Fed. Dist. Engr. approved project statement involving constr. of road from Talladega to Calhoun county line; section from Stemley to join F. A. P. 14; chart construction, Talladega county, $369,017. For detailed information address St. Hwy. Dept., Montgomery.

Ala., Tuscumbia—Colbert County will bui'd roads here; $250,000 bonds voted; also constr. of 16.7 mi. topsoil surfacing road from Lafayette to Randolph county line; $80,000.

Ala., Wetumpka—State Hwy. Dept. plans constr. of 7¼ miles of road in Elmore county; $162,777.

Ark., Little Rock—City Engr. Lawrence reports that 26 blks. of concrete will be added to city hwys. Thirteenth street will be paved from Main street west to Sycamore; Sycamore north from 13th to 16th streets; 16th street west to city limits.

Ark., Osceola—Miss. Co. will construct hard-surfaced road from Wardell to Whitton; $160,000 bonds.

Cal., Bakersfield—Council has decided to pave streets in 17 blocks in central part of town with Willite, including portions of A, D, E, F and G streets, and has ordered City Eng. R. E. Hubbard to prepare plans and specfs. Council has also decided to pave Sumner street, King to Edison Hwy., which is first of three projects to connect county highways.

Cal., Newport Beach—City having plans prepared for paving Central avenue and all streets in Balboa and East Newport; 5 to 7 inch concrete. About $350,000. P. Kressley, I. W., Hellman Bldg., Los Angeles, Engr.

Cal., Riverside—Bond issue of $655,000 for additional county hwy. impvts. is being agitated by chambers of commerce of Riverside county. Projects contemplated, 8 in number, include the Ehrenberg crossing, est. cost $60,000; Mecca-Thermal Rd., $120,000; W. Riverside brdg., $100,000; Jack Rabbit Trail (6 miles), $100,000; Corona-Elsinore Rd. (9 miles), $125,000; Hammer avenue, $75,000; Jack Rabbit Trail, San Jacinto (9 miles), $135,000; road east of Hemet (2½ miles), $50,000.

Fla. Clearwater—Pinellas Co. considering road construction; plans issuing $750,000 to $1,250,000 bonds.

Ga., Albany—Dougherty Co. will expend $400,000 for road construction.

Ga., Atlanta—Fulton Co. will expend $1,000,000 during 1921 for road construction; asphalt or concrete paving.

Ill., Cairo—Alexander Co. plans to surface county highways, gravel on concrete base. About $300,000. W. J. Johnson, Chrmn Commrs., R. M. Miller, 609 Ohio street.

Ill., Carbondale—Plans being prepared for paving various streets; brick on conc. base. About $127,000. E. A. Fox, W. Frankfort, Engr.

Ill., Chicago—Bd. Local Impvts., 207 City Hall, had specfs. prepared for 400,000 sq. yds. paving. C. D. Hill, Chf. Engr.

Ill., Waukegan—Paving Sheridan Road to city limits is under consideration by City Comn. here. City Engr. instructed to prepare necessary plans and specfs.

Ind., Indianapolis—Plans for resurfacing East Washington St.—Noble Street to Audubon Rd.—have been ordered prepared and work on proj. is expected to be started this Summer. Bd. Public Wks. announces that for parts of streets now paved with brick, specfs. will have a provision for new surf. of asphalt over the brick. Prelim. orders made for use of bitum. conc. in perm. impvt. of Churchman Ave.—Prospect St. to Woodlawn Ave.; also 28th St.—Illinois to Meridian Sts. Plans ordered for permanent impvt. of Temple Ave.—Southeastern Ave. to C., I. & W. R. R.; perm. impvt. and walks in Julian Ave.—Butler to Spencer Aves., and for opening and widening Madison Ave.—Raymond St. to Pleasant Run Parkway, north drive, by adding 8-ft. strip on west side. Resolutions adopted for vacation of 1st alley east of Park Ave.—Fall Crk. Pkway, no. drive to 29th St.

Ind., Kokomo—Primary resolutions for impvt. of 4 streets, adopted by Board of Works. Petition received from abt. 15 residents asking impvts. on So. Union St.—Virginia Ave. to Defenbaugh St.—with concrete; impvt. to include walks and curbs.

Ia., Lamoni—City considering paving 25 blks., 50 ft. wide, asph. conc. and brick. Abt. $70,000. N. A. Shockley, Graphic Arts Bldg., Kans. City, Mo., Engr.

Ia., Sioux City—Paving of Riverside Blvd. strongly advocated by City Planning Comn., Interstate Fair Comn., Riverside Community Club and boat clubs. Boulevard extends from No. Riverside so. to Riverside Park—more than a mile. Council decided to have St. Dept. furnish estimate of cost of paving.

Ky., Princeton—Caldwell Co. will sell $200,000 bonds for road construction. J. F. Canada, Judge.

La., Leesville—Vernon Parish will construct roads; $225,000 available.

La., Shreveport—City Council adopted 14 Ords., introduced by Commr. Thoman, accepting work already done and providing for other streets to be paved in near future. Resolution also adopted by Mayor Ford to borrow $160,000 on certificates of indebtedness in anticipation of its revenues. Streets to be paved are as follows: Greenwood to Mansfield Rd.; Olive St.—Highland to Gilbert; Wilkinson St.,—Barret to Sanford; Jordan St. to Colby; Louisiana to Line—Rutherford St.—Gilbert to Wesley.

Mass., Pittsfield—Paving, drain and sidewalk

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants.
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Surface Heaters.
Barber Asphalt Paving Co.

Asphalt Tools.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Barber Asphalt Paving Co.
Littleford Brothers.

Auto Fire Apparatus.
Diamond T Motor Car Co.
Duplex Truck Co.
Garford Co., The
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Back Fillers.
Austin Machinery Corporation.
Pawling and Harnischfeger.

Barber Brand Cold Repair Cement.
Barber Asphalt Paving Co.

Bar Cutters and Benders.
Koehring Machine Co.

Bars, Reinforcing.
Truscon Steel Co.

Bermudez Road Asphalt.
Barber Asphalt Paving Co.

Binders, Road.
Barber Asphalt Paving Co.
The Texas Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bitulithic Pavements.
Warren Bros. Co.

Bodies.
Lee Loader and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Bridges.
Lewis-Hall Iron Works.

Buckets, Dredging, Excavating and Sewer.
Pawling and Harnischfeger.

Buckets, Dumping.
Littleford Brothers.
Pawling and Harnischfeger.

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Pullers, Electric.
Mead-Morrison Mfg. Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Testing.
Kirschbraun, Lester.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Lewis-Hall Iron Works.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Chutes, Concrete.
Heltzel Steel Form & Iron Co.
Littleford Brothers.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Machine Co.
Smith Co., T. L. The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Conduits, Wood, Creosoted.
Republic Creosoting Co.

Consulting Engineers.
Alvord, John W.
Artingstall, Wm.
Brossmann, Chas.
Burd & Giffels.
City Wastes Disposal Co.
Dow & Smith.
Fargo Engineering Co.
Flood, Walter H., & Co.
Samuel A. Greeley.
Hill & Ferguson
Howard, J. W.
Hunt & Co., Robert W.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Potter, Alexander.
Shields, W. S.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.
Koehring Machine Co.
Littleford Bros.
Smith Co., T. L. The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Co., Ltd., The

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling and Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Crushed Stone.
Cleveland Stone Co., The

Culvert Molds.
Austin-Western Co., Ltd., The

Culvert Pipe, Cast Iron.
American Cast Iron Pipe Co.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Curbing, Sandstone.
Cleveland Stone Co., The

Direct Oxidation Process.
Direct Oxidation Process Corp.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.

Dryers.
Cummer & Son Co., The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Ords., aggregating $98,000 adopted by Bd. of Aldermen. Paving loan orders aggregate $82,500 and provide for paving portions of East Street around City Hall park, Maplewood Ave., Francis Ave. and Fenn St.

Mich., Detroit—City contemplates paving with sheet asph. on 8-in. conc. base (a) berea curbstone, (b) medina curbstone, Stoepel Ave.—Grand River to Stoepel Ave. Subdiv., cost (a) $17,140, (b) $17,950, Taylor Ave.—Lawton to Dexter Aves. (a) $36,620, (b) $35,420.

Minn., New Ulm—Will construct high water road across Minn. river, no. of Eagle Roller Mill Co. plant. Abt. $150,000. Herman Polkow, Chrmn. Co. Commrs.

Minn., Pipestone—Chas. M. Babcock, St. Hwy. Commr. has ordered approximately $180,000 worth of impvts. on Minn. Trunk Hwy. No. 6 betw. Lake Benton and Trosky. Projects are: Grading and gravel surfacing 22 miles betw. Lake Benton and Trosky. Est. cost $150,000 (brdgs. & culvts. included); paving 1 mile thru city of Pipestone. Est. cost $30,000.

Mo., Jefferson City—State Hwy. Dept., Jefferson City, plans to construct 23 miles Dexter, Malden, Kennett State Rd. F. A. P. 183, Dunklin Co., involving 23,000 sq. yds. excav., 47, 520 sq. yds. conc. and 168,378 sq. yds. gravel pavement, etc. Abt. $403,000.

Mo., St. Joseph—State Hwy. Dept. Jefferson City, plans to constr. 6.5 miles St. Joseph-Dearborn St. Rd., Buchanan Co., F. A. P. 180; 24-ft. surfacing and one-course conc. pavement. $351,532. A. C. Singley, Div. Engr.

Mo., St. Joseph—Buchanan County having prelim. plans prepared for bldg. 9 miles Pikes Peak Hwy. from 102 river to Bayfield St., 18 ft. wide. Abt. $473,000. J. D. Mohler, Court House, Engr.

Miss., Vicksburg—City will pave 12 streets, including Jackson, Clay and Common, etc.

N. J., Trenton—Bd. Freeholders, Mercer Co. having plans prepared for penetrating 2 miles Carter Rd., 30 ft. wide, Lawrence Twp., with tar on slag base. Abt. $100,000. H. Harris, Court House, Engr.

N. C., Gastonia—According to County Commrs. Gaston County, work will soon begin on constr. of 3 main rd. projects: Lincoln Rd., Cleveland Rd., via Bessemer City and continuation of road in York Co. line. Abt. $500,000 will be expended on the main hwy. work in county.

N. C., Raleigh—State Hwy. Comn., authorized constr. of Charlotte-Statesville Hwy. Est. cost approx. $1,000,000; has also ordered immediate constr. of Charlotte-Statesville-Davidson Rd. of 45 miles and erection of 2 rock crushing plants. Plants will cost approximately $200,000.

N. C., Raleigh—State Hwy. Dept. ordered immediate construction of 482 miles gravel and hard surfaced highways. Est. cost $7,000,000.

Ore., Oregon City—City considering hard surfacing, in near future, upper 7th St. and Washington from 7th to 14th Sts.

O., Findlay—Council has decided on street impvt. program calling for expendt. of more than $100,000.

O., Mt. Gilead—Morrow County has decided to macadamize 2½ miles of rd.—a continuation of Jackson Rd., Crawford Co.

Pa., Erie—As soon as plans are approved contract will be let for paving 2½ miles road on E. Lake Rd. to Throp Rd. Road will be built by state aid.

Pa., Munhall, Homstead—6 Ords. passed by Munhall Council, 5 of which are for grading and paving 19th, 20th, 2nd and 22nd Aves. and Maple St.

Tex., Cleburne—St. Hwy. Dept. Austin, has approved plans for constr. of 12 mi. bitum. mac. rd. on Hwy. No. 2A, Johnson Co. Est. cost $329,192.25. C. C. Chisman, Co. Judge; Thos. C. Davis, Asst. Co. Engr.

Tex., Crowell—$150,000 bonds voted to construct roads in Foard Co. L. Noland, Co. Engr.

Tex., Edinburg—Hidalgo County plans constr. of 34.3 miles Hwy. 12—Edinburg to Brooks county line; $252,828. P. S. Devine, Co. Engr. Phar.

Tex., Gonzales—Gonzales County plans constr. of 12.04 mi. 15-ft. gravel rd. on Middlebuster Hwy. 29. $163,188. J. C. Ronberg, Co. Judge; J. W. Benjamin, Co. Engr.

Tex., Lufkin—Angelina County plans to grade, pave and drain 10 miles Hwy. 40—Huntington to Marion, involving 70 acres clearg. and grubbing 20,000 cu. yds. earth excav., 522 cu. yds. 1:2:4 conc., 20,899 cu. yds. gravel surfacing; abt. $115,000; grade, pave, drain, etc., 16 mi. St. Hwy. 7, $162,404. J. E. Hurd, Co. Engr.

Tenn., Madisonville—Monroe Co. plans to construct Lee Hwy., consisting of 16 miles Knoxville-Maryville-Athens Rd.; $160,000. May vote on $260,000 bonds.

Tex., Port Lavaca—Calhoun Co. plans constr. of 11.5 miles 12-ft. shell surfaced rd. on Highway No. 29; $88,000. R. H. Phillips, Co. Engr., 510 National Bk. of Com. Bldg., San Antonio.

Utah, Brigham City—Plans for a continuation of the hard surf. rd. bldg. program in Boxelder Co. being considered. It is desired to continue hard surafcing state hwy. from terminus in city on no. through Bear River valley.

Utah, Price—State Hwy. Comn. Salt Lake City, plans hard-surfacing, grading, bldg., culvts. and bridges, on 10.45 mi. rd. Carbon Co.—Price to Castlegate. Abt. $560,000. Carbon Co. voted $190,000 bonds as its portion of cost. Fed. Govt. will also appropriate toward cost. R. J. Schultz, Castlegate, Engr.

Va., Lynchburg—City will pave 5th, 12th, Commerce and other sts.; construct sewers on streets; $123,500. Constr. by city forces. E. A. Beck, City Mgr.

SEWERAGE AND SEWAGE TREATMENT

Ala., Birmingham—Estimates of cost of constructing big 3-ft. san. sewer in business district here will be made at once by Julian Kendrick, City Engr.

Ark., Little Rock—Majority of property owners have signed petition for organization of large sewer district in western portion of city. Formation of district will be authorized by Council at next meeting. Value of property in dist. is estimated at about $3,000,000. Est. cost of sewer abt. $200,000. It will extend abt. 13,000 ft. and take care of sewage of 19 districts.

Cal., Los Angeles—Plans prepared for constr. of 5.17 mi. storm drainage system, large rein. conc. drains and vit. pipe laterals from Madison Ave. and Temple St. to point so. of Pico St. Abt. $2,000,000. J. T. Griffin, City Hall Annex, Engr. City also having plans prepared for bldg. 7.65 miles main line sewer in 23rd St.—Hooper to Maple Aves. also 44.95 mi. laterals and storm drains in W. Jefferson St., etc. Abt. $4,000,000. J. T. Griffin, City Hall Annex, Engr.

Ont., Niagara Falls—City plans to construct Muddy Run sewer. About $250,000. James, Proctor and Redfern, 36 Toronto St., Toronto, Engrs.

Conn., New Haven—City plans to extend sewers in Chapel and Crescent Sts. Abt. $120,000. E. S. Nettleton, Bureau of Engrg., City Engrs.

Ind., Crown Point—City considering about ½ mi. 8-in. san. sewer extension. F. Knight & Sons, City Engrs.

Ia., Creston—City contemplates bldg. 4 mi. san. and storm sewers. Abt. $50,000. P. H. DeVoe, City Engr.

Ky., Frankfort—C. F. Crecelius, Engineer, will survey and draw up specfs. for big trunk line sewer in Thorn Hill. Engineer confident sewer can be built for the $75,000 authorized in bond issue voted last Nov. Specfs. expected to be completed within 30 days.

Ky., Frankfort—City—W. S. Rosson, Mayor—plan issuance of $75,000 bonds to construct, extend and improve storm water and san. sewers from Ky. Penitentiary to Glenwood Pk., thence to Ky. river.

Mich., Detroit—City plans to construct lateral sewers costing abt. $75,000 in various thoroughfares. C. W. Hubbell, City Engr.

Minn., Minneapolis—If City receives proceeds of recent sale of $350,000 sewer bonds Council Comm. on Sewers will recommend constr. of a number of new sewers; $200,000 will probably be appropriated for work on Minnehaha Crk. sewer and the remainder used for mains and laterals where most needed.

Minn., Stillwater—Plans being prepared for constructing outlet sewer in Mulberry St. Abt. $57,787. J. A. D. Abercrombie, Stillwater, Engr.

Mo., Eldon—Prelim. plans being prepared for san. sewers and disp. plant. Abt. $125,000. E. T. Archer & Co., New England Bldg., Kansas City, Engrs.

Mo., Independence—$130,000 bonds voted and plans being prepared for 3 disp. plants and ejector stations. Burns & McDonnell, Interstate Bldg., Kansas City, Engrs.

Mont., Billings—Work of laying laterals in west end sewer systems abandoned last year because

BUYERS' GUIDE

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Edge Protector.
Truscon Steel Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Elevators.
C. H. & E. Mfg. Co.

Engineering Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Engines.
C. H. & E Mfg. Co.
Midwest Engine Co.

Excavating Machinery.
F. C. Austin Machinery Co.
Pawling and Harnischfeger.
Sauerman Bros.
Smith Co., T. L. The

Expansion Joint Compound.
The Barrett Co.
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co.

Fence, Iron.
Cincinnati Iron Fence Co.

Fillers (Paving Joint).
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms (Sewers & Conduits).
Heltzel Steel Form & Iron Co.

Forms (Wall Bldg., Construction, Etc.).
Heltzel Steel Form & Iron Co.

Gas Pipe.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Graders.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gravel Screener and Loader.
Good Roads Machinery Co., Inc.
Jordan & Steele Mfg. Co., Inc.

Heaters (Rock and Sand).
Littleford Bros.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling and Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling and Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Lewis-Hall Iron Works.
Mead-Morrison Mfg. Co.

Hot Mixers.
F. C. Austin Machinery Co.
Barber Asphalt Paving Co.

Hydrants.
The Flower Company.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
Pioneer Asphalt Co.

Joint Fillers (Paving).
The Barrett Co.
The Texas Company.

Kettles (Portable).
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Loaders.
Brown Portable Conveying Machine Co.

Manhole Covers.
Madison Foundry Co.
Dee Co., Wm. E.

Mastic.
Pioneer Asphalt Co.

Meter Boxes.
McNutt Meter Box Co.

Mixers, Asphalt.
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Sons Co., The F. D.

Mixers, Concrete.
Austin Machinery Corporation.
Koehring Machine Company.
T. L. Smith Co.

Mixers—Mortar.
C. H. & E. Mfg. Co.

Molds (Pipe & Culvert).
Heltzel Steel Form & Iron Co.

Motor Fire Apparatus.
Acme Motor Truck Co.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Trucks.
Acme Motor Truck Co.
Duplex Truck Co.
Diamond T Motor Car Co.
Federal Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Motor Truck Flushers, Sprinklers and Oilers.
Acme Motor Truck Co.
Austin Machinery Corporation.
Diamond T Motor Car Co.
Duplex Truck Co.
Federal Motor Truck Co.
Garford Motor Truck Co., The
The Gramm-Bernstein Motor Truck Co.
Kissel Motor Car Co.
Lewis-Hall Iron Works.
Packard Motor Car Co.
Pierce-Arrow Motor Car Co.

Municipal Castings.
Dee Co., Wm. E.
Madison Foundry.

Packing.
Pioneer Asphalt Co.

Paints (Asphalt).
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.

Paving Blocks (Creosoted).
The Barrett Co.
Republic Creosoting Co.

Paving Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
National Paving Brick Mfrs. Assn.
Springfield Paving Brick Co.

Paving Contractors.
Warren Bros Co.

Paving Joint Compound.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Joint Filler.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Company.

Paving Machines.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Warren Bros. Co.

Paving Plants (Asphalt).
Austin Machinery Corporation.
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Smith Co., T. L. The
Warren Bros. Co.

Pipe Cutters.
W. W. Strickler & Bro.

Pipe Dip and Coatings.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.

Pipe Manufacturers.
American Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdy. Co.

Pitch Filler.
The Barrett Co.
Warren Bros. Co.

Plows (Rooter and Wing).
Austin-Western Road Cach. Co.

Portable Paving Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
East Iron & Machine Co., The
Good Roads Machinery Co., Inc.
Littleford Brothers.
Warren Bros. Co.

Portable Stone Bins.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Pumps.
C. H. & E. Mfg. Co.
De Laval Steam Turbine Co.
Harris Air Pump Company.
Midwest Engine Co.
Smith Co., T. L., The

Reinforcing For Pavements.
American Steel and Wire Co.
Truscon Steel Co.

Road Building Material.
Barber Asphalt Paving Co.
Kentucky Rock Asphalt Co.
Sinclair Refining Company.
The Texas Co.

of city's inability to dispose of bonds, will be resumed; $80,000 bonds have been sold.

Neb., Benkelman—Sewerage system contemplated. Royal D. Salisbury Co., Cons. Engrs., Denver, authorized to make tentative plans.

Neb., Grant—City having prelim. plans prepared for bldg. sewers and disposal plant. Abt. $50,000. Henningson Engrg. Co., 3rd floor Natl. Bldg., Omaha, Engrs.

N. J., Trenton—City plans to construct sewage disp. plant. Est. cost abt. $750,000. F. W. Donnelly, Mayor; J. R. Fell, Engr., City Hall.

N. H., Manchester—According to report of sewer survey, submitted to aldermen, sewer impvts. will call for immediate expendt. of $750,000 and total expendt. of $1,550,000 for entire project.

N. Y., Susquehanna—Borough Council will sell bonds amounting to $40,000 for purpose of constructing sewers.

N. Y., Syracuse—City plans to build 1,350 ft. and 3,950 ft. 90-in. concrete outfall sewer from sewage plant into Onondaga Lake. Abt. $100,000. G. Holmes, City Hall, Engr.

N. C., Asheville—City plans to issue $40,000 bonds for sewer extens. B. M. Lee, City Engr.

O., Springfield—Plans being prepared for bldg. sewerage system and sewage disp. plant. Abt. $1,000,000. G. B. Gascoigne, Cons. Engr., Cleveland, O.

Okla., McAlester—Citizens voted in favor of $50,000 bonds for an addition to sewer system.

Ore., Pendleton—City plans to construct septic tank and incinerator. Abt. $50,000. Boar & Cunningham, Portland, Cons. Engrs. F. B. Hayes, local engineer, Pendleton.

Ore., Portland—City Council has authorized the hard surfacing of Foster Road in dist. west of Lents and constr. of trunk sewer. First unit will extend to 92nd St. and Johnson Creek and second unit to the Willamette River, probably running at all points within city limits. City Engr. Laurgaard estimated entire sewer would cost property owners approx. $68 for each 50-ft. lot.

Pa., Erie—Constr. of sewers in Glenwood Park and Academy Dists. Will be started this Summer. Est. cost $175,000. Mr. Eichhorn, St. Director.

Tex., Slaton—City will construct 8 miles 7 to 12 in. tile sewer. R. J. Murray, Mayor.

Wis., Madison—Council voted $69,000 to complete sewage disposal plant. Includes new sludge beds with glass top, blower, electric hoist, etc. City Engr. E. E. Parker.

Wis., Whitefish (Milwaukee P. O.)—Villages of Whitefish and Shorewood having plans prepared by F. W. Ullins, Vil. Engr., Shorewood, 1288 Murray Ave., and H. C. Webster, Engr. Whitefish, 216 W. Water St., for 1 mile intercepting sewer from Atwater Rd. to No. Shorewood limits, and siphon under Milwaukee River from Lake St. to Atwater Rd., probably concrete. Cost bet. $65,000 and $70,000.

WATER SUPPLY AND PURIFICATION

N. S., Halifax—City has authorized issuance of $249,000 bonds to construct water works system.

Ont., Hanover—Plans and ests. being prepared for addns. to water system, including new water mains, reservoirs, pumps, etc. Abt. $50,000. F. W. Thorold, 167 Avenue Rd., Toronto, Engr.

Ont., Richmond Hill—Village Council have instructed James, Proctor & Redfern, Ltd., Cons. Engrs., Toronto, to advertise for bids immediately for installing water works system.

Ont., Tilbury—James, Proctor & Redfern, Ltd., Cons. Engrs., Toronto, have submitted report to town in which is recommended constr. of an elevated water tower, surf. reservoir and motor and gasoline-driven pumping equipt. Est. cost $33,000.

Colo., Siebert—City contemplates sale of $50,000 bonds; funds to be used for constr. of water wks. system.

D. C., Washington—$200,000 item for commencement of work on enlarged water supply for District, inserted in Army appropriation bill by Senate, accepted by House. Development of water sys. will be in accord. with plans submitted by Major Tyler of War Dept.

Fla., Miami—Miami Water Wks. Co., Western Blvd., bet. D and E Sts., having plans prepared by Hazen, Whipple & Fuller, 30 E. 42nd St., N. Y. City, for comb. filtr. and softener plant. Abt. $500,000. H. H. Hyman, Engr.

Fla., Palatka—City will purchase water works; expend $45,000 on impvts.

Ill., Bellwood—City plans to construct new water works system; abt. $167,000. J. A. Fippenger, Pres. E. A. Rossitor, 127 N. Dearborn St., Chicago, Engr.

Ill., Flora—City having plans prepared for extending water works and improving elec. light and power plants. Work includes laying 4.8 water mains and adding 1 unit to power plant. Abt. $40,000. Fuller & Beard, Chem. Bldg., St. Louis, Mo., Cons. Engrs.

Ill., Galesburg—City considering constructing 4 6-in. cast iron water mains in various streets. Abt. $100,000. Private plans.

Ill., Hanover—Town voted $30,000 bonds and plans are being prepared for 1-sty., 110x112 ft. brk. power plant, including centrif. pumps and Monor steel tank serv. connection from pipe hydrants, etc. Holland, Ackerman & Holland, 106 E. Liberty St., Ann Arbor, Mich., Engrs.

Ill., Waukegan—City Council passed ord. for constr. of water mains in Dodge Sub-div. and sewers in Buell's Sub-div. Ests. for comb. projects, approx. $150,000—$67,028 for water supply impvt.

Ind., Ft. Wayne—$50,000 bonds issued for purpose of purchasing new equipt. for pumping stations L and 4, and for laying water mains in rolling mill district. Bd. Pub. Wks. plans for extension of water line on 4th St., Franklin Ave. to Schilling Ave.

Ind., Indianapolis—City authorized by Pub. Serv. Comn. to sell bonds of $50,000 for extensions and impvts. to water works.

Kans., Ottawa—City Commrs. authorized to issue $96,000 bonds for constr. of filtr. system at Ottawa water works system plant. Issue is in addn. to $165,000 bonds recently voted for improving elec. power plant.

Neb., Fremont—City having plans prepared for laying 4, 6 and 8-in. water mains in various streets. Abt. $75,000. F. G. Pierce, Clk. L. M. Roessler, Fremont, Engr.

Neb., Hershey—Town will have $50,000 additional water and light equipment.

N. Y., No. Tonawanda—City contemplates bldg. filtr. plant. Abt. $200,000. C. L. Oelkers, City Hall, City Engr.

N. D., Steele—Plans under way for water works system for fire protection. Includes fresh water well, 100-ft. tower, mains, hydrants and 50,000-gal. standpipe; $33,000.

O., Youngstown—Mayor Warnock has signed bond issue of $500,000 to construct belt line water works sys. around city. Work will start at once.

S. D., Beresford—City plans to improve water works and power plant. Abt. $70,000. W. W. Yorker, Clk. Dakota Engrg. Co., Mitchell, Engrs.

S. D., White Lake—City having plans prepared for water works sys., including reservoir, 4 and 6-in. mains, etc. Abt. $40,000. Smith & Reeves, Mitchell, Engrs.

Tenn., Greenville—City considering voting on $250,000 bonds to improve water works.

Tex., Corpus Christi—City will construct conc. settling basin at Calallen pumping plant; 400x200 ft. with sloping sides and maximum depth of 14 ft.; install sys. of floating valves; bottom of basin to have 12-in. slope for drainage; increase capy. to 10,250,000 gals.

Tex., Quanah—City voted $100,000 water works extension bonds; constr. 5-mile water lines; 1,000,000-gal. capy. reservoir; install pumping plant equipt.

Utah, Ogden—$625,000 bonds voted for 6 to 24-in. water mains, valves, hydrants, etc., in various streets. T. M. Tracy, City Engr.

Utah, Scofield—Town Board will soon open bids for bldg. dam and 4 miles of pipe line to connect with water supply from Green Canon, iron pipe to be used in town; possibly wooden pipe from reservoir to town (2 mi.); $31,000 bonds voted. W. W. Jones, Price, Engr.

Va., St. Paul—Town voted $65,000 water and sewer bonds. G. L. Pugh, Chmn. Council. Will construct 150,000-gal. capy. plant. $45,000; erect 20x18 ft. brk. filtr. house; install $5,000 pumps and filtr. plant machy; erect 150,000-gal. capy. rein. conc. reservoir. Will ask bids later. W. A. Bennett, Engr., Rocky Mount, Va.

Wyo., Basin—Plans completed by Prince-Nixon Co., Omaha, for water plant. Provide for new settling basins, filtration sys. installation of gas engines, etc.

BUYERS' GUIDE

Road Binder.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Road Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Road Graders.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Road Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Cummer & Son Co., The F. D.
Good Roads Machinery Co., Inc.
Littleford Brothers.
Midwest Engine Co.
Warren Bros. Co.

Road Planer.
Austin-Western Road Machinery Co., The

Road Oil and Preservatives.
Barber Asphalt Paving Co.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Road Rollers.
Austin-Western Road Machinery Co., The
Barber Asphalt Paving Co.
Good Roads Machinery Co., Inc.

Rock Crushers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Roofing Material.
Barber Asphalt Paving Co.
The Barrett Co.
Pioneer Asphalt Co.
The Texas Co.
Warren Bros. Co.

Sand Dryers.
Cummer & Son Co., The F. D.
Littleford Brothers.

Saw Rigs.
C. H. & E. Mfg. Co.

Sandstone.
Cleveland Stone Co.

Scarifiers.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Drag Line.
Pawling and Harnishchfeger.
Sauerman Bros.

Scrapers, Graders, Plows, Etc.
Austin-Western Road Machinery Co., The
Good Roads Machinery Co., Inc.

Scrapers, Power.
Sauerman Bros.

Sewage Treatment.
Direct Oxidation Process Corp.

Sewer Braces.
Kalamazoo Fdry. & Mach. Co.
Dee Co., Wm. E.
Madison Foundry Co.

Sewer Cleaning Machinery.
Stewart, W. H.

Sewer Forms.
Heltzel Steel Form & Iron Co.

Sewer Pipe.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Sewer Rods.
Stewart, W. H.

Sidewalks (Stone).
Cleveland Stone Co.

Sluice Gates.
Coldwell-Wilcox Co.

Snow Removal Machinery.
Austin Machinery Corporation.
Good Roads Machinery Co., Inc.

Special Castings.
The Flower Company.
U. S. Cast Iron Pipe & Fdy. Co.

Sprinklers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co., The

Steel Joists, Studs and Sash.
Truscon Steel Co.

Steel Tapes.
Kolesch & Co.
Lufkin Rule Co., The

Stone Crushers.
Austin-Western Road Machinery Co., The

Stone Curbing.
Cleveland Stone Co.

Stone Elevators.
Austin-Western Road Machinery Co., The

Stone Flagging.
Cleveland Stone Co.

Stone Spreaders.
Austin-Western Road Machinery Co.
Burch Plow Works Co.

Stone Screens.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Littleford Brothers.

Street Cleaning Machinery (Horse Drawn).
Austin-Western Road Machinery Co.

Street Crossings.
Cleveland Stone Co.

Street Flushers (Horse Drawn).
Austin-Western Road Machinery Co.

Street Paving Material.
Barber Asphalt Paving Co.
The Texas Co.

Street Sprinklers (Horse Drawn).
Austin-Western Co., Ltd., The

Structural Steel.
Lewis-Hall Iron Works.

Surveyors' Instruments.
Kolesch & Co.
Lufkin Rule Co., The

Sweepers.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Tamping Machines.
Pawling and Harnischfeger.

Tanks, Water Supply.
Mensch, L. J.
Littleford Brothers.

Tar and Pitch.
The Barrett Co.

Tar Heaters.
Littleford Bros.

Tarvia.
The Barrett Co.

Testing Chemists.
Dow & Smith.
Walter H. Flood.
Howard, J. W.
Kirschbraun, Lester.
Van Trump, Isaac.

Traction Engines.
Austin-Western Road Machinery Co.

Traction Engines (Oil or Kerosene).
Austin-Western Road Mach. Co.

Tractors.
Austin Machinery Corporation.
Holt Mfg. Co., Inc.

Trailers.
Lee Loader and Body Co.

Trench Braces.
Kalamazoo Fdry & Mich. Co.

Trench Machinery.
Austin Machinery Corporation.
Kalamazoo Fdy. & Machine Co.
Pawling and Harnischfeger

Trinidad Lake Asphalt.
Barber Asphalt Paving Co.

Turbines, Steam.
De Laval Steam Turbine Co.

Valves.
Coldwell-Wilcox Co.
The Flower Company.

Wall Coping.
Cannelton Sewer Pipe Co.

Warranite.
Warren Bros. Co.

Water Main Cleaning.
National Water Main Cleaning Co.

Water Pipe.
American Cast Iron Pipe Co.
Cast Iron Pipe Publicity Bureau

Waterproofing.
Barber Asphalt Paving Co.
Barrett Co., The
Pioneer Asphalt Co.
The Texas Co.
Truscon Steel Co.

Water Purification.
Direct Oxidation Process Corp.
Pennsylvania Salt Mfg. Co.

Water Softener.
The Refinite Co.

Water Works Supplies and Equipment.
American Cast Iron Pipe Co.
Coldwell-Wilcox Co.
The Flower Company.
Mueller Mfg. Co.
Pennsylvania Salt Mfg. Co.

Wheeled Scrapers.
Austin-Western Road Machinery Co.

Wire Rope.
American Steel & Wire Co.

Windows (Steel).
Truscon Steel Co.

Wire-Cut Lug Brick.
Medal Paving Brick Co.
Metropolitan Paving Brick Co.
Murphysboro Paving Brick Co.
Springfield Paving Brick Co.

Wood Block (Creosoted).
Barrett Co., The
Republic Creosoting Co.

Wood Preservatives.
Barrett Co., The
Republic Creosoting Co.

INDEX TO ADVERTISEMENTS

Alvord, John W., & Charles B. Burdick, Chicago, Ill. 37
American Appraisal Co., Milwaukee, Wis.... 37
American Cast Iron Pipe Co., Birmingham, Ala. 35
American Steel & Wire Co., Chicago, Ill..... 6
American Telephone & Telegraph Co., New York, N. Y. 9
Artingsall, Wm., Chicago, Ill..... 37
Austin-Western Road Machinery Co., Chicago, Ill. 4
Austin Machinery Corporation, Chicago, Ill.

Barrett Co., The, New York, N. Y..... 21
Bitoslag Paving Co., New York, N. Y.....
Brossman, Chas., Indianapolis, Ind..... 37
Burch Plow Works Co., Crestline, Ohio..... 29
Burd & Giffels, Grand Rapids, Mich..... 37
Buyers' Guide 37, 39, 41

Cannelton Sewer Pipe Co., Cannelton, Ind... 10
Chicago Paving Laboratory, Chicago, Ill.... 37
City Wastes Disposal Co., New York, N. Y... 37
Cleveland Stone Co., The, Cleveland, Ohio... 10
Coldwell-Wilcox Co., Newburgh, N. Y..... 38
Cummer & Son Co., The F. D., Cleveland, Ohio 29

Dee Clay Mfg. Co., W. E., Chicago, Ill..... 29
Dee, Wm. E., Chicago, Ill..... 10
De Laval Steam Turbine Co., Trenton, N. J.
Direct Oxidation Process Corp., Philadelphia, Pa. 38
Dow & Smith, New York, N. Y..... 37
Duplex Truck Co., Lansing, Mich.....
DuPont DeNemours & Co., E. I., Wilmington, Del. 7

Engineers and Contractors.....37, 38

Fargo Engineering Co., Jackson, Mich..... 37
Federal Motor Truck Co., Detroit, Mich..... 13
Flood, Walter H., Chicago, Ill..... 37
Flower Co., Detroit, Mich..... 38

Gannet, Steelye & Fleming, Harrisburg, Pa.. 37
Granite Paving Block Mfrs. Assn. of the U. S., Inc., Boston, Mass..... 8

Harris Air Pump Co., Indianapolis, Ind.....
Heltzel Steel Form & Iron Co., Warren, Ohio .....Inside front cover
Hill & Ferguson, New York, N. Y..... 37
Holt Mfg. Co., Inc., The, Peoria, Ill..... 8
Howard, J. W., New York, N. Y..... 37
Hunt, Robert W. & Co., Chicago, Ill..... 37

Jones, Sam L., Cincinnati, Ohio..... 38
Jordan & Steele Mfg. Co., Inc., Charlotte, Mich. .....

Kalamazoo Foundry and Machine Co., Kalamazoo, Mich. 10
Kentucky Rock Asphalt Co., Louisville, Ky.
Kirchoffer, W. G., Madison, Wis..... 38
Kissel Motor Car Co., Hartford, Wis..... 15
Koehring Co., Milwaukee, Wis.....22, 23
Kolesch & Co., New York, N. Y..... 33

Lewis-Hall Motors Corp., Detroit, Mich.....
Littleford Bros., Cincinnati, Ohio..... 27
Lufkin Rule Co., The, Saginaw, Mich..... 29

Macnaughton, David, Ft. Wayne, Ind..... 38
Madison Foundry Co., Cleveland, Ohio..... 10
Metropolitan Paving Brick Co., Canton, O...
Midwest Engine Co., Indianapolis, Ind.....
Motor Truck Section.....11, 20
Mueller Mfg. Co., H., Decatur, Ill..... 33
Murphysboro Paving Brick Co., Murphysboro, Ill. 10

National Paving Brick Mfrs. Assn., Cleveland, Ohio .....

Olsen Testing Machine Co., Philadelphia, Pa. 10

Packard Motor Car Co., Detroit, Mich.....
Pawling & Harnischfeger Co., Milwaukee, Wis. 25
Pennsylvania Salt Mfg. Co., Philadelphia, Pa. 38
Pierce-Arrow Motor Car Co., Buffalo, N. Y..
Pioneer Asphalt Co., Lawrenceville, Ill..... 8
Portable Machinery Co., Inc., Passaic, N. J.. 2
Portland Cement Association, Chicago, Ill...
Potter, Alexander, New York, N. Y..... 38

Republic Creosoting Co., Indianapolis, Ind... 10
Rosing Inc., Astrid S., Chicago, Ill..... 38

Sauerman Bros., Chicago, Ill..... 27
Shields, W. S., Chicago, Ill..... 38
Smith, Co., The, T. L., Milwaukee, Wis.....
Standard Oil Co. (Indiana), Chicago, Ill.... .....Inside back cover
Stensrud, Herman, Marquette, Mich..... 38
Stewart, W. H., St. Louis, Mo..... 35
Strickler, W. W., & Bros., Columbus, Ohio.. 35
Sullivan, Long & Hagerty, Bessemer, Ala... 38

Texas Co., Asphalt Sales Dept., New York, N. Y. 5
Truscon Steel Co., Youngstown, O..... 4
And Back Cover

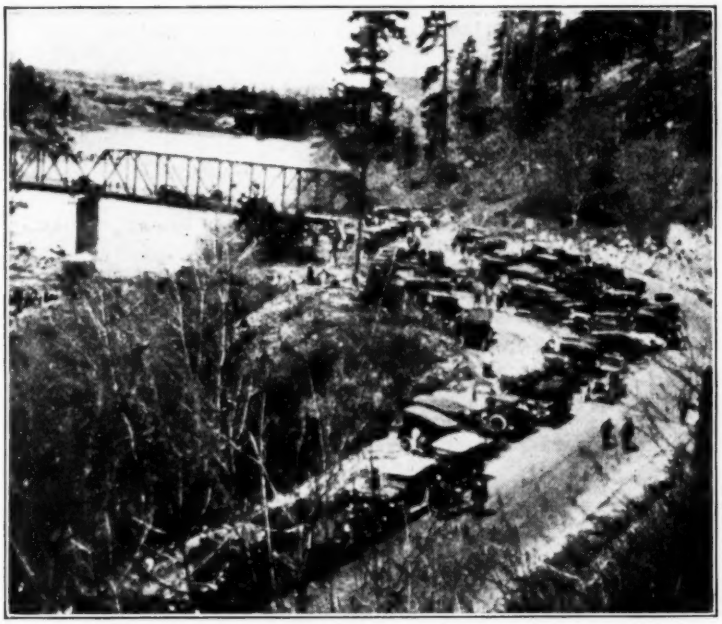
United States Cast Iron Pipe & Foundry Co., Burlington, N. J. 35
Uvalde Asphalt Paving Co., New York, N. Y. 10

Van Trump, Isaac, Chicago, Ill..... 38

Warren Brothers Co., Boston, Mass..... 1
Webster Mfg. Co., The, Chicago, Ill.....
Wells, James P., Rochester, N. Y..... 38

Compressed Stone Base for Warrenite-Bitulithic Pavement

This form of base has been thoroughly and successfully tested for many years under widely varying climatic and subsoil conditions, and has proven eminently satisfactory, including over 200 miles on the Columbia River Highway, Oregon, shown in illustration below.



COLUMBIA RIVER HIGHWAY, PORTLAND, OREGON
Warrenite-Bitulithic Surfacing over Old Macadam Sandy Road. Approach to the Columbia River Highway at Sandy River Bridge.

SERVICE AND QUALITY

the essential features in laying of Warrenite-Bitulithic. We furnish expert laboratory service with every pavement laid. The result is shown by the phenomenal growth of Warrenite-Bitulithic.

INSIST ON THE WARREN WAY

Illustrated Booklet on Compressed Stone Base furnished upon request, as well as other features of Warrenite-Bitulithic.

Warren Brothers Company

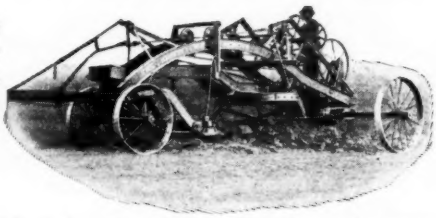
Executive Offices: 9 Cambridge St., Bowdoin Sq., BOSTON, MASS.

DISTRICT OFFICES:

New York, N. Y.	St. Louis, Mo.	San Francisco, Cal.	Vancouver, B. C.
Utica, N. Y.	Phoenix, Ariz.	Richmond, Va.	Toronto, Ont.
Portland, Ore.	Washington, D. C.	Memphis, Tenn.	Winnipeg, Man.
Chicago, Ill.	Minneapolis, Minn.	Los Angeles, Cal.	

It's Good for What Ails Your Roads

Take a scarifier that does not turn up its teeth at the hardest surfaces, add a grader blade directly behind it to finish the job in one operation, put both on a grader frame strong enough to stand the gaff—and you have



The Austin Rip-Snorter

Improved roads that have gone to the bad are a nightmare to travelers and a tough problem for those charged with keeping them in repair.

No lasting good will result unless these worn-out, ravelled, pot-holed roads are first scarified, then graded and finally rolled—a lengthy and expensive job if each operation is done separately.

The Rip-Snorter is the ideal machine ror such work. It scarifies and grades at the same time—saving time, labor and expense.

Many other uses are constantly being found for the Rip-Snorter. For instance, it is A-1 for removing an old road surface preparatory to laying a more improved type. The old material is scarified and piled along the roadsides where it can be used to form the shoulders of the new road, or if this is not desirable, easily loaded into wagons.

Special Rip-Snorter Bulletin O should be in your files.

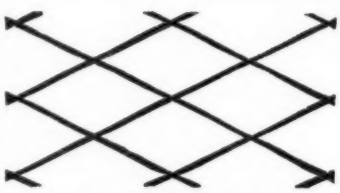
The Austin-Western Road Machinery Co.

CHICAGO, ILLINOIS.

Branches in Twenty-two Cities.

ALMACO — EXPORT DEPARTMENT ALLIED MACHINERY COMPANY OF AMERICA — ALMACO

Reinforcing Steel Saves Expense on Concrete Roads



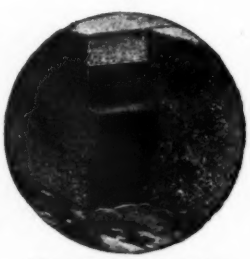
Truscon Road Mesh

Reinforcing steel increases strength and reduces maintenance.

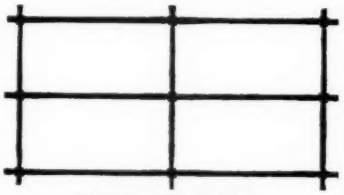
Truscon Products insure the right reinforcement for concrete roads.

Truscon Road Mesh is an expanded metal with 6x12-inch diamond mesh—furnished in flat sheets 5 feet wide and various lengths.

TRUSCON STEEL CO. TRUSCON BUILDING PRODUCTS



Truscon Contraction Joint



Truscon Wire Mesh

Truscon Wire Mesh is furnished either in rolls or in large flat sheets, easily handled and placed.

The use of Truscon Contraction Joint completes and perfects the construction. Write for literature and estimates.

Truscon Steel Co.

YOUNGSTOWN, OHIO

Warehouses and Representatives in Principal Cities.